OPERATING AND SERVICE MANUAL

MODEL 608C

VHF SIGNAL GENERATOR

All Serials

MANUAL PART NO. 00608-90036
Microfiche Part No. 00608-90037

HEWLETT hp PACKARD

Property of J.L FAIRBAIRN

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This manual applies directly to instruments with serial numbers 832-07540 and above.

With changes described in Appendix II, this manual also applies to instruments with serial numbers 832-07539 and below

1501 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.

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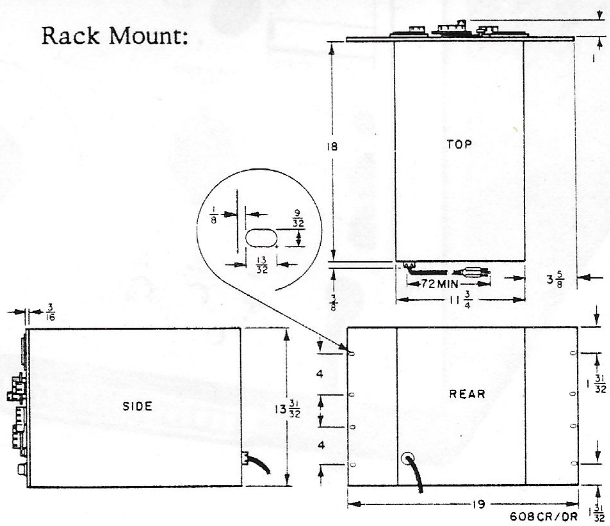
LIST OF ILLUSTRATIONS

SPECIFICATIONS

Frequency Range:	10 mc to 480 mc in 5 bands.
Tuning Control:	Frequency control mechanism provides a main dial calibrated in megacycles and a vernier dial for interpolation purposes. Total Scale Length: Approximately 45 inches. Calibration: Every other megacycle 130 to 270 mc; every 5 mc above 270 mc.
Vernier Control:	A separate vernier control allows variations of about ±25 kc (at high frequencies) to provide precise frequency setting for sensitivity checks of extremely selective receivers.
Frequency Calibration Accuracy:	Within ±1% over entire frequency range.
Resettability:	Better than ±0.1% after initial instrument warm-up.
Frequency Drift:	Less than 0.005% over a 10 minute interval after initial instrument warmup (15°C to 35°C ambient).
Output Level:	0.1 microvolt to 1.0 volt (into a 50-ohm resistive load). Attenuator dial calibrated in volts and dbm. (0 dbm equals 1 milliwatt in 50 ohms.)
Output Voltage Accuracy:	±1 db over entire frequency and attenuation range (into a 50 ohm resistive load).
Generator Impedance:	50 ohms, maximum swr 1.2
Internal Modulation Frequencies:	400 cps ±10% and 1000 cps ±10%
External AM Modulation:	From 0 to 95% at output levels of 0 dbm and below from modulation frequencies 20 cps to 20 kc. Input requirements, 0.5 volt rms across 15K ohms.
Modulation Meter Accuracy:	±10% of full scale, 30% to 95% modulation
Envelope Distortion:	Less than 5% at 30% sine-wave modulation and less than 10% at 50% sine-wave modulation.

SPECIFICATIONS (CONT'D.)

External Pulse Modulation:	Positive 5 volt peak pulse required. 40 mc to 220 mc; combined rise and decay time of rf pulse less than 4 microseconds. 220 mc to 480 mc; combined rise and decay time of rf pulse less than 1 microsecond. Residual level at least 20 db below 1 volt peak pulse output.
Incidental Frequency Modulation:	Less than 0.0025% at 30% amplitude modulation for rf output frequencies from 21 to 480 mc.
Leakage:	Negligible; permits receiver sensitivity measurements down to at least 0.1 microvolt.
Power:	115/230 volts ±10%, 50-1000 cps, approximately 220 watts.
Dimensions:	Cabinet Mount: 13-1/4 in. wide, 16-3/8 in. high, 21 in. deep. Rack Mount:



Weight:	Cabinet Mount: Net 62 lbs, shipping 72 lbs Rack Mount: Net 62 lbs, shipping 87 lbs
Accessories Available:	hp 11508A Output Cable provides 50 ohm termination and standard binding posts at the end of a 24 inch length of cable. Allows direct connection of the signal generator to high impedance circuits. hp 11509A Fuse Holder provides protection of the attenuator elements when the 608 is used for transceiver tests.

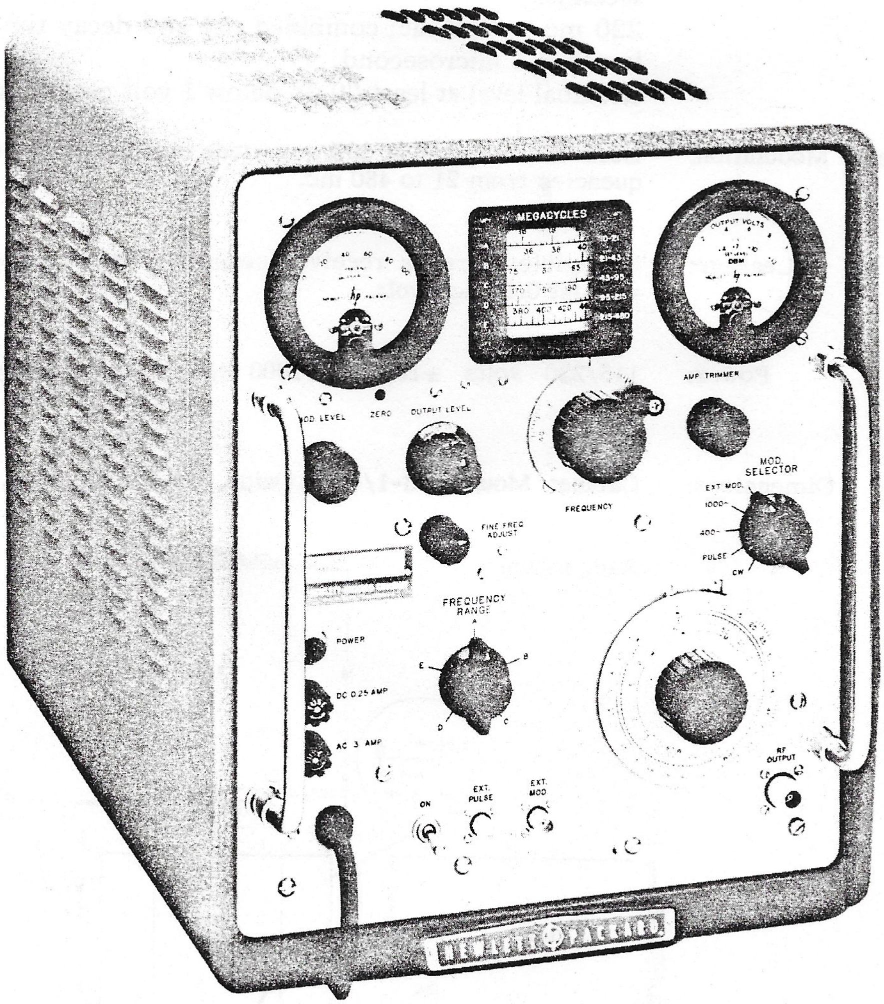


Figure 1-1. Model 608C VHF Signal Generator

SECTION I
GENERAL DESCRIPTION

1-1 INTRODUCTORY

The Hewlett-Packard Model 608C VHF Signal Generator is a general purpose test instrument which furnishes accurately adjustable r-f signals from 0.1 microvolt to 1 volt over the frequency range from 10 to 480 megacycles. The output signal may be amplitude modulated by internally generated sine waves or by externally applied sine waves or pulses. The output signal level is adjustable by an attenuator calibrated in both volts and dbm and can be read directly to an accuracy of ±1 db over the full frequency and attenuation range without the use of external pads, monitoring devices, or charts. The 608C features a very wide frequency range, high output, and straightforward operation through the use of reliable, direct-reading controls and meters.

The Model 608C Signal Generator is designed for general applications in the 10- to 480-megacycle frequency range, such as testing, calibrating, and trouble shooting VHF radio equipment and circuits. In conjunction with other test equipment, the 608C is useful for measuring standing wave ratios, antenna and transmission line characteristics, receiver sensitivity, etc. To obtain best accuracy in these applications, care has been taken to hold spurious modulation from the generator to a very low value.

1-2 AUXILIARY EQUIPMENT

SUPPLIED -

The special wrench necessary for removing the r-f amplifier tube. It is mounted on the instrument chassis.

AVAILABLE -

hp 11509A Fuseholder.. To protect the output attenuator from damage, for some applications (such as transceiver testing) it is desirable to insert a fuse between the 608C and external equipment. The 11509A is a special coaxial fuseholder which houses a type 8AG, 1/16 amp. fuse which protects the output attenuator from damage in the event that an external voltage is accidentally applied to the RF OUTPUT connector. The fuseholder has an insertion loss of 0.50 db at 200 mc, 0.56 db at 300 mc, and 0.65 db at 400 mc; its swr is not greater than 1.35 when connected to a 50 ohm resistive load.

hp 11508A Terminated Output Cable. This cable assembly provides a 50-ohm termination and standard binding posts at the end of a 24-inch length of cable. The 11508A allows direct connection of the 608C to a high-impedance circuit.

1-3 GENERAL ELECTRICAL CHARACTERISTICS

The Model 608C Signal Generator furnishes a continuously adjustable r-f output signal from 10 to 480 megacycles. The frequency is indicated on a drum-type dial calibrated to be read directly in megacycles with a maximum error of ±1%. A short range incremental tuning device is provided for making extremely small changes in the output signal frequency. The fine frequency tuner is operated from the front panel by a small knob to the left of the main FREQ. control knob.

An output attenuator, calibrated to be read directly in volts and decibels to an accuracy of ±1 db or better over the entire attenuation and frequency range, varies the output signal from +7 dbm to -127 dbm (500 millivolts to 0.1 microvolt) when connected to an external 50-ohm resistive load. The internal impedance of the generator, as seen at the output jack, is nominally 50 ohms over the full frequency range; and when connected to a 50-ohm resistive load, the vswr due to mismatch will not be greater than 1.2.

The r-f output from the 608C may be sine wave amplitude modulated from either an internal 400 or 1000 cps r-c oscillator or with an external signal 20 to 20,000 cps with an amplitude of at least 0.5 volt. All sine wave modulation is continuously adjustable from 0 to 95% by a front panel control. The percent modulation is continuously monitored

and indicated on a front panel modulation meter calibrated directly in percent modulation. Calibration accuracy is better than ±10% of the meter reading at modulation percentages between 30% and 95%.

The envelope of a sine wave modulated signal contains less than 5% distortion. Incidental amplitude modulation of the cw output signal is less than 0.1%. The level of any harmonic or spurious signal contained in the cw output signal is 40 decibels below the level of the output signal when the output level is greater than 200 microvolts.

The 608C may be pulse modulated from an external source of positive pulses of at least 5 volts amplitude. R-f output pulses have a combined rise and decay time as short as 4 μsec at 40 mc, 2 μsec at 100 mc, and less than 1 μsec above 200 mc.

The Model 608C is suitable for aligning narrow-band a-m receivers. In such applications a significant amount of spurious f-m in the generator usually results in misalignment of the receiver because the selectivity characteristics of the receiver has the ability to detect the f-m. To keep spurious f-m to a negligible value (less than 0.0025% at 30% modulation for frequencies above 21 megacycles), the instrument employs a master oscillator-power amplifier (MOPA) type of r-f generator circuit. Modulation is introduced at the power amplifier stage and has a very little effect on the frequency of the oscillator.

To minimize r-f leakage, all r-f signal circuits are housed in an aluminum casting. Leakage is such that when the output signal is adjusted for 0.1 microvolts, the conducted signal leakage at any other front panel connector and the radiated leakage two inches from the instrument are each less than 1.0 microvolt.

All plate circuits in the instrument are operated from regulated d-c voltage. In addition, the heaters in the r-f oscillator and power amplifier tubes are operated from a regulated d-c power supply to enhance the stability of the system. The instrument is designed to operate from a nominal 115/230-volt, 50- to 400-cycle, single-phase a-c power source and consumes approximately 150 watts.

Further information is given in the Table of Specifications at the beginning of this manual.

1-4 SUPPLY VOLTAGE

The 608C, like other ⓗⓟ instruments, is normally shipped from the factory with the dual 115 volt primary windings of the power transformer connected in parallel. If operation from a 230 volt source is desired, the windings may be quickly reconnected in series. Refer to the schematic drawing at the rear of the manual. Remove the jumpers from terminals 1-4 and 2-5. Connect a jumper between terminals 4-5. Replace the 3.2 ampere slow blow fuse with a 1.6 ampere slow blow fuse.

1-5 POWER CABLE

The three conductor power cable supplied with this instrument is terminated in a polarized three prong male connector recommended by the National Electrical Manufacturers' Association. The third contact is an offset round pin added to a standard two blade connector which grounds the instrument chassis when used with an appropriate receptacle. To use this connector in a standard two-contact receptacle, an adapter should be used to connect the NEMA connector to the two contact system. When the adapter is used, the third contact is terminated in a short lead from the adapter which can then be connected to the (grounded) connector mounting box in order to ground the instrument chassis.

1-6 PHYSICAL DESCRIPTION

All r-f signal circuits and the output attenuator are housed in an aluminum die casting divided into three compartments. For ease in r-f tube replacement, the two r-f tubes are located in the uppermost compartment, separate from the tuned circuits. This compartment is accessible by removing the small plate under the frequency dial drum. The compartments containing the tuned circuits are accessible when the side plate is removed.

All controls, meters, and terminals are located on the front panel and are marked with large, white-filled, engraved letters. The frequency dial is of the drum type with a scale length of 11-1/2 inches for each band, or approximately 57 inches for the entire range. The full frequency range is covered in five bands, each band being read on a separate dial scale. A pointer, automatically positioned, indicates the scale in use.

1-7 INSTRUMENT IDENTIFICATION

Hewlett-Packard uses a two-section eight-digit serial number (000-00000). If the first three digits of the serial number on your instrument do not agree with those on the title page of this manual, change sheets supplied with this manual will define differences between your instrument and the Model 608C described in this manual.

1-8 INSPECTION

Refer to the warranty sheet in this manual.

SECTION II
INSTALLATION AND OPERATION

2-1 INTRODUCTORY

This section contains instructions for installing and operating the Model 608C VHF Signal Generator. The information contained in this section is as follows:

2-2 GENERAL

The Model 608C generates a radio frequency signal from 0.1 microvolt to 1 volt over the frequency range from 10 to 480 megacycles. The r-f output signal may be modulated by internally generated sine waves at 400 and 1000 cps or by externally developed sine waves or pulses with modulation percentage being indicated on a direct-reading front panel meter. The generator is designed to operate into a resistive load of 50 ohms; and when so loaded, the output voltage and power may be read directly from the output attenuator dial in conjunction with a front panel output level meter.

2-3 INSTALLATION

Since the 608C is a portable equipment designed for test-bench use and not for permanent installation, no special installation procedure is necessary. Both the signal generator and the equipment under test should be within arm's reach of the operator, with connecting leads between the equipments kept as short as possible.

CAUTION: Do not obstruct the ventilating louvers on the sides of the instrument cabinet. Safe operating temperature depends on free air flow through these louvers.

When the signal generator is to remain idle for extended periods of time, it is desirable to store the instrument in a place that will prevent moisture and dust from entering the cabinet and also prevent possible damage to front panel jacks and cabinet.

2-4 OPERATING CONTROLS, DIALS, AND TERMINALS

The front panel operating controls, dials, and terminals for the 608C are listed with their functions in Figure 2-1. A simplified block diagram showing which circuits are affected by various front panel controls is shown in Figure 2-2.

2-5 TURNING ON THE EQUIPMENT

To place the signal generator into operation, proceed as follows:

a. With power switch in "off" position, connect the power cord to the power source.

b. Place the MOD. SELECTOR in the CW position and the OUTPUT LEVEL control 75% of full clockwise rotation. Other controls may be set in any position before turning generator on.

c. Turn power switch to the ON position. The POWER pilot lamp should indicate that power is applied to all circuits of the signal generator.

d. After approximately 1 minute warm-up adjust the AMP. TRIMMER for maximum reading and OUTPUT LEVEL control to obtain a SET LEVEL reading on the front panel OUTPUT VOLTS meter.

e. Allow equipment to heat for 5 minutes before use. If greatest frequency stability is required, allow equipment to heat for 45 minutes.

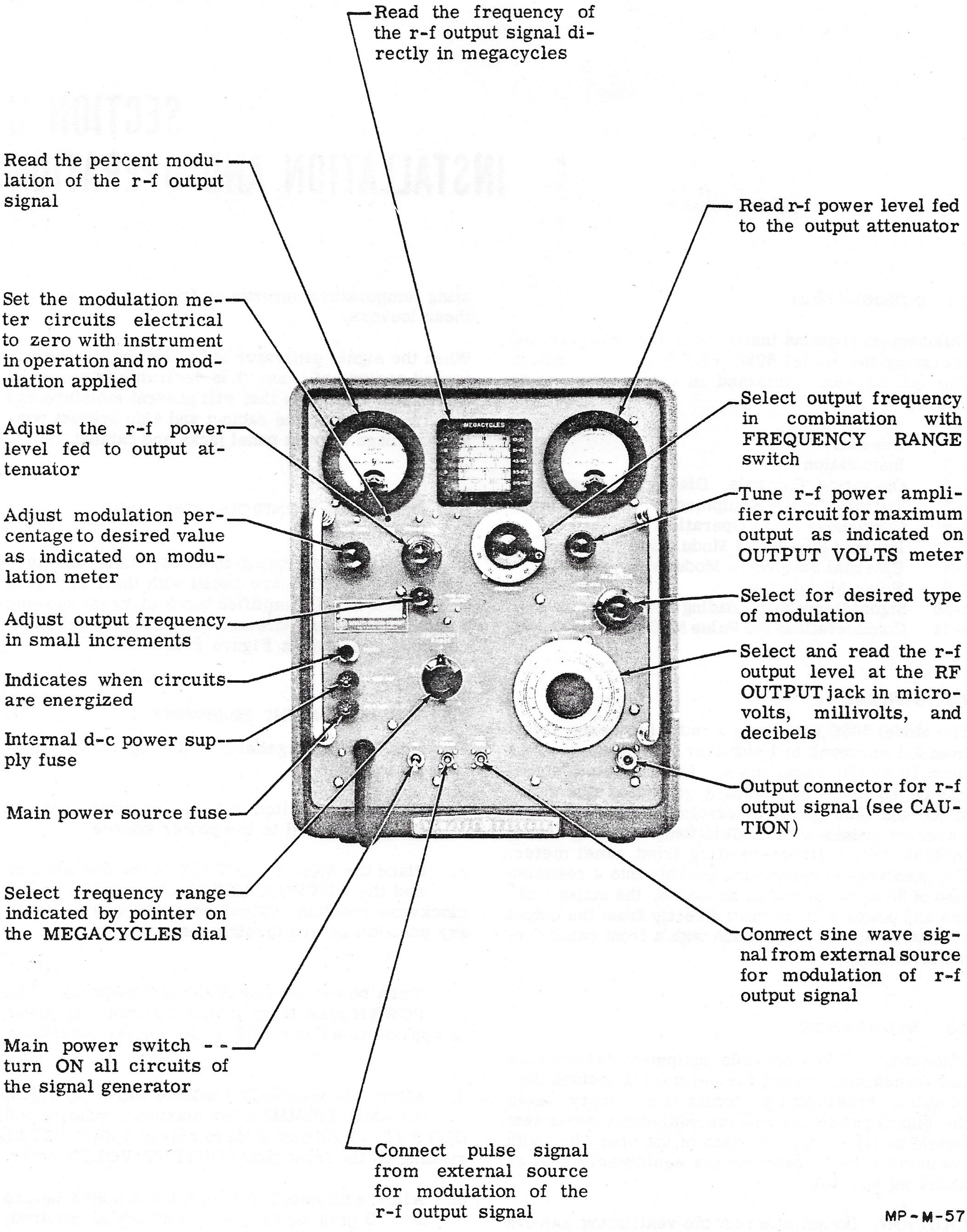


Figure 2-1. Model 608C Front Panel Controls

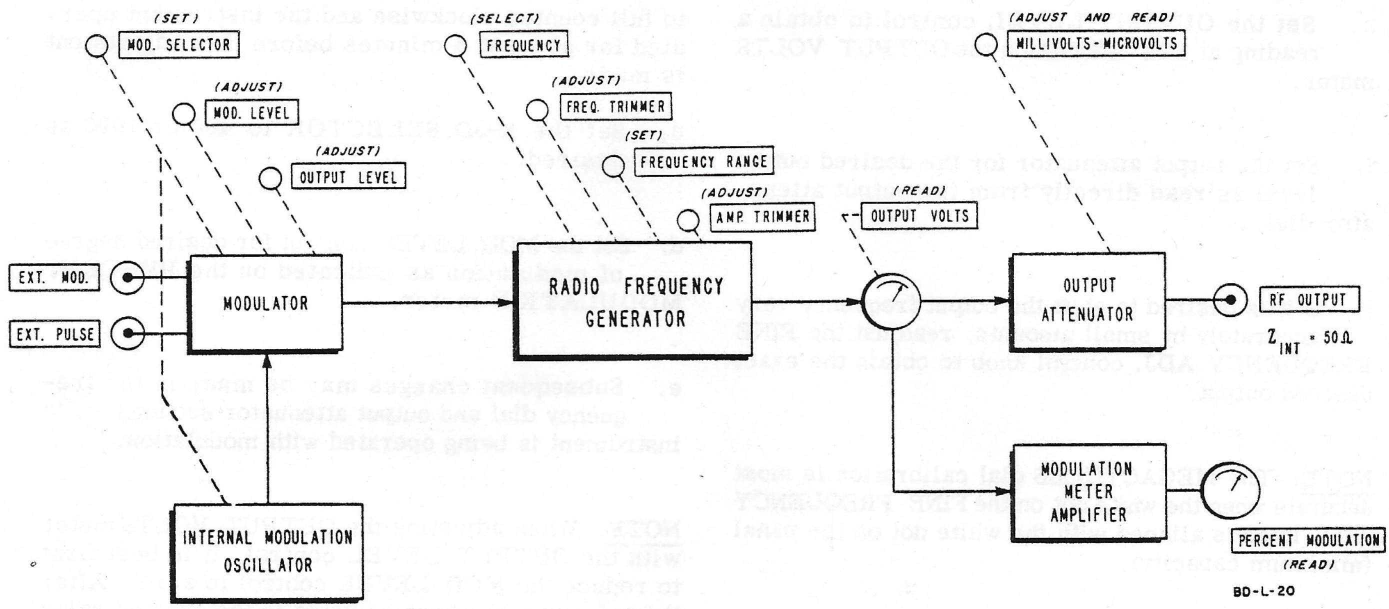


Figure 2-2. Diagram Showing Relationships of Front Panel Controls to Major Circuits

CAUTION: Do not connect any source of r-f or d-c power to the RF OUTPUT jack on the Model 608C Signal Generator. To do so will burn out the impedance-matching network in the output attenuator. Special care must be taken when working with "transceiver" type equipments to insure that the transmitter remains inoperative while the signal generator is connected to the equipment antenna connector.

NOTE: To protect the output attenuator, a special fuseholder (hp Stock No. 11509A is available for connection to the RF OUTPUT jack. Where there is the possibility of voltage being applied to the RF OUTPUT jack, this fuse should be used between the output jack and external equipment.

2-6 CONTINUOUS WAVE OPERATION

GENERAL -

When 608C is set for CW operation, the PERCENT MODULATION meter may have momentary fluctuations due to switching transients.

STEP-BY-STEP PROCEDURE FOR OBTAINING CW OPERATION -

a. Following the "turning on" procedure described in paragraph 2-5, set the MOD. SELECTOR to CW.

b. Select the desired band of frequencies with the FREQUENCY RANGE selector.

c. Set the FINE FREQUENCY ADJ. control knob so that the white dot on the knob is aligned with the white dot on the front panel.

d. Set the MEGACYCLES dial to the desired frequency.

e. Set the OUTPUT LEVEL control to near maximum.

f. Adjust the AMP. TRIMMER for maximum output as indicated on OUTPUT VOLTS meter.

g. Connect the external load to the RF OUTPUT jack on the signal generator. (See preceding CAUTION.)

h. Set the OUTPUT LEVEL control to obtain a reading at SET LEVEL on the OUTPUT VOLTS meter.

i. Set the output attenuator for the desired output level as read directly from the output attenuator dial.

j. If it is desired to shift the output frequency very accurately by small amounts, readjust the FINE FREQUENCY ADJ. control knob to obtain the exact desired output.

NOTE: The MEGACYCLES dial calibration is most accurate when the white dot on the FINE FREQUENCY ADJ. knob is aligned with the white dot on the panel (minimum capacity).

2-7 INTERNAL SINE WAVE MODULATION

GENERAL -

For internal sine modulation of the r-f output signal, the 608C supplies the same quality r-f signal as is obtained for cw operation and which may be modulated by either 400- or 1000-cycle internally generated sine waves selected by the MOD. SELECTOR switch. The modulating frequencies are accurate to within ±5% and envelope distortion of the modulated carrier is less than 5% for modulation percentages to 30%; 10% at 50% modulation.

The degree of modulation is continuously adjustable from 0 to 95% by the MOD. LEVEL control and is indicated on the PERCENT MODULATION meter to an accuracy of ± 10% of full scale from 30% to 95%. Incidental frequency modulation resulting from amplitude modulation of the output signal is held very low. Output frequency and power level are set in the same manner as for cw operation except that the MOD. SELECTOR is set to 400 or 1000.

STEP-BY-STEP PROCEDURE FOR OBTAINING INTERNAL MODULATION -

a. Follow complete step-by-step procedure for obtaining cw operation.

b. Adjust the PERCENT MODULATION meter electrical zero if needed, by inserting a small screwdriver through the front panel hole labeled ZERO and turning the control to bring the pointer to zero. The MOD. LEVEL control should be set to full counter clockwise and the instrument operated for at least 5 minutes before this adjustment is made.

c. Set the MOD. SELECTOR to 400 or 1000 as desired.

d. Set the MOD. LEVEL control for desired degree of modulation as indicated on the PERCENT MODULATION meter.

e. Subsequent changes may be made in the frequency dial and output attenuator settings while instrument is being operated with modulation.

NOTE: When adjusting the OUTPUT VOLTS meter with the OUTPUT LEVEL control, it is best first to reduce the MOD. LEVEL control to zero. After the r-f output has been adjusted to the desired value and the AMP. TRIMMER adjusted for peak output, the MOD. LEVEL control is advanced in a clockwise direction until the PERCENT MODULATION meter indicates the desired degree of modulation.

It may be noticed that when the percent modulation is increased to very high levels there will be a resulting increase in the reading of the OUTPUT VOLTS meter. The OUTPUT LEVEL control should be reset to maintain a reading at SET LEVEL on the OUTPUT VOLTS meter.

2-8 EXTERNAL SINE WAVE MODULATION

GENERAL -

An external signal source generating frequencies from 20 to 20, 000 cycles per second with an amplitude above .5 volts may be used to modulate the r-f output signal from the signal generator. The degree of modulation is also continuously adjustable by means of the MOD. LEVEL control and is indicated directly on the front panel PERCENT MODULATION meter. The modulating signal is applied through an appropriate cable to the EXT. MOD. jack on the front panel. The input impedance at the EXT. MOD. jack is approximately 50, 000 ohms.

STEP-BY-STEP PROCEDURE FOR OBTAINING EXTERNAL MODULATION -

a. Follow complete step-by-step procedure for obtaining cw operation.

b. Set MOD. SELECTOR to EXT. MOD. position.

c. Connect modulating source to EXT. MOD. jack.

d. Set MOD. LEVEL control for desired degree of modulation as read on the PERCENT MODULATION meter.

e. Subsequent changes may be made in frequency dial and output attenuator settings while the instrument is being operated with modulation.

NOTE: It may be noticed that when the percent modulation is increased to very high levels there will be a resulting increase in the readings of the OUTPUT VOLTS meter. The OUTPUT LEVEL control should be reset to maintain a reading at SET LEVEL on the OUTPUT VOLTS meter.

2-9 PULSE MODULATION

GENERAL -

An external pulser generating positive pulses from 10 to 50 volts in amplitude may be used to modulate the r-f output signal from the 608C Signal Generator. The resultant r-f output pulse from the signal generator is of good quality at r-f frequencies above 100 megacycles, is free of transients, and has low residual signal between pulses. For pulse operation the signal generator produces essentially no r-f output signal until an external positive pulse is applied to the EXT. PULSE jack. The amplitude of the modulation pulse is not adjustable by the MOD. LEVEL control. Any pulse of 10 volts amplitude or better will 100% modulate the r-f output signal, the peak of the r-f output pulse being within 1 db of the cw level established by the same settings of the OUTPUT LEVEL control and output attenuator.

STEP-BY-STEP PROCEDURE FOR OBTAINING PULSE-MODULATED OUTPUT -

a. Follow complete step-by-step procedure for obtaining cw operation.

b. Set the MOD. SELECTOR to the PULSE position.

c. Connect modulating source to EXT. PULSE jack on front panel.

2-10 SIGNAL GENERATOR LOADING CONSIDERATIONS

When using the Model 608C, the external load connected to the instrument should be 50 ohms resistive for best accuracy of indicated output power. The output attenuator dial has been calibrated by using a resistive load of 50 ohms. The internal impedance of the generator is sufficiently close to 50 ohms so that in the worst case a vswr of only 1.2 maximum exists when the generator is measured from an external signal source of 50 ohms. Error in power level indication with this magnitude of vswr will have no important effect on the accuracy of the output attenuator dial. However, if the value of the load is not known and if best accuracy in measurements is desired, it is necessary that the standing wave ratio in the line to the load be minimized.

Table 2-1 shows the calculated power loss when the load on the signal generator causes a voltage standing ratio of the magnitudes shown. The vswr values shown are actually a comparison between a load and a 50-ohm transmission line. Mismatches causing the voltage standing wave ratios given in the left-hand column will give power losses somewhere between the limits shown in the remaining two columns. The minimum loss figures in columns 2 and 3 assume a mismatch of 1.2 vswr between the signal generator and transmission line, the minimum loss being indicated in column 2, maximum loss in column 3. The maximum loss shown is the total loss from the maximum power available from the generator for a given setting of the output attenuator and includes the possible generator vswr of 1.2. The data does not allow for losses in the transmission line to the load, for in most cases such losses are sufficiently small so that they are not of importance.

It will be seen that when the load is matched to the transmission line the loss from the maximum power available from the signal generator is approximately 0.06 db in the worst case. Although the losses as shown in db do not consist of large numerical values, it should be noted on the attenuator dial that they may represent a considerable change in the voltage calibration so far as the voltage impressed across the external load is concerned.

In most cases when making measurements on receivers designed to work from a 50-ohm line and antenna, the standing wave ratio in the line from the signal generator to the receiver is not significant. The reason for this is that any power reflected from the receiver back towards the generator represents a deficiency in receiver design, and the amount of power lost in such cases is considered as a loss subtractive from the gain of the receiver. A sometimes overlooked factor which contributes error in high-frequency measurements is the improper assembly of coaxial connectors. A standing wave ratio of several db with attendant error can often be attributed to this cause.

Table 2-1. Power Losses as Related to VSWR in Generator Load

VSWR in 50-ohm Line	Min. Power Loss	Max. Power Loss
1.0	.06 db	.06 db
1.5	.08 db	.37 db
2.0	.3 db	.85 db
2.5	.6 db	1.3 db
3.0	.9 db	1.7 db
4.0	1.5 db	2.4 db
5.0	2.0 db	3.1 db

2-11 CONSIDERATIONS FOR PULSE-MODULATED R-F OUTPUT

Because the bandwidth of the tuned r-f amplifier circuit increases as frequency is increased, the rise and decay times of high speed pulses decrease as the signal generator output frequency is increased. The following table lists the approximate minimum pulse widths that may be expected at the upper and lower frequency limits of the B, C, D, and E frequency bands.

Frequency bands	Combined rise and decay	Min. pulse width for output pulse equal to CW level ±1 db
B band	2 to 5 μsec	1-1/2 to 4 μsec
C band	1-1/2 to 4 μsec	1-1/4 to 3 μsec
D band	3/4 to 2 μsec	3/4 to 2 μsec
E band	1/2 to 1 μsec	1/2 to 1 μsec

SECTION III
THEORY OF OPERATION

3-1 GENERAL

The electrical circuits of the Model 608C Signal Generator are divided into the sections shown in the block diagram in Figure 3-1, plus a power supply which is not shown.

The operation of the various sections is as follows:

a. The radio frequency oscillator generates the r-f signal which is fed through a power amplifier to the output jack of the signal generator. The oscillator is of the Colpitts type and provides a continuously variable sine wave signal of high stability.

b. The radio frequency power amplifier receives both the r-f and modulation signals and ampli-

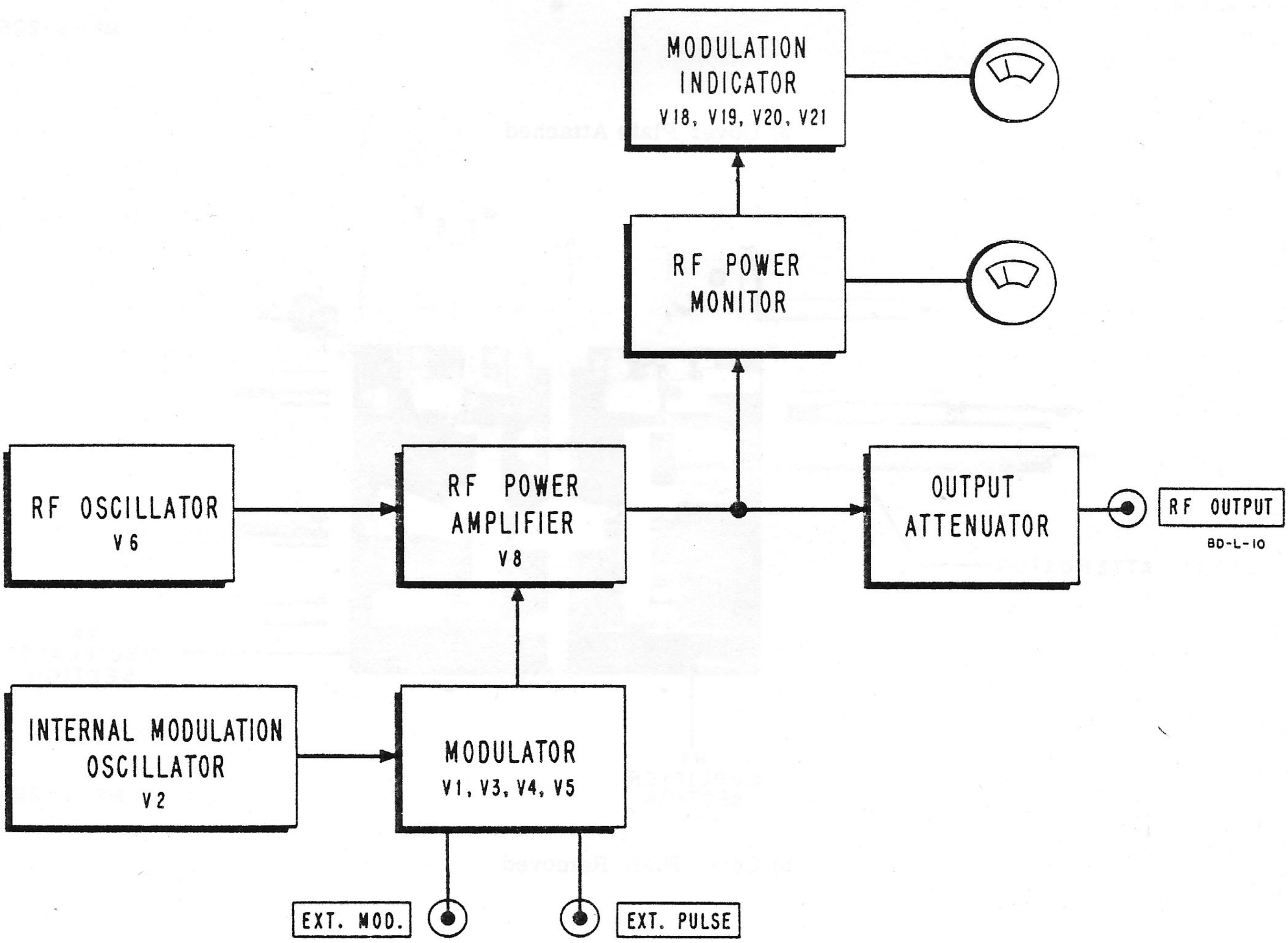
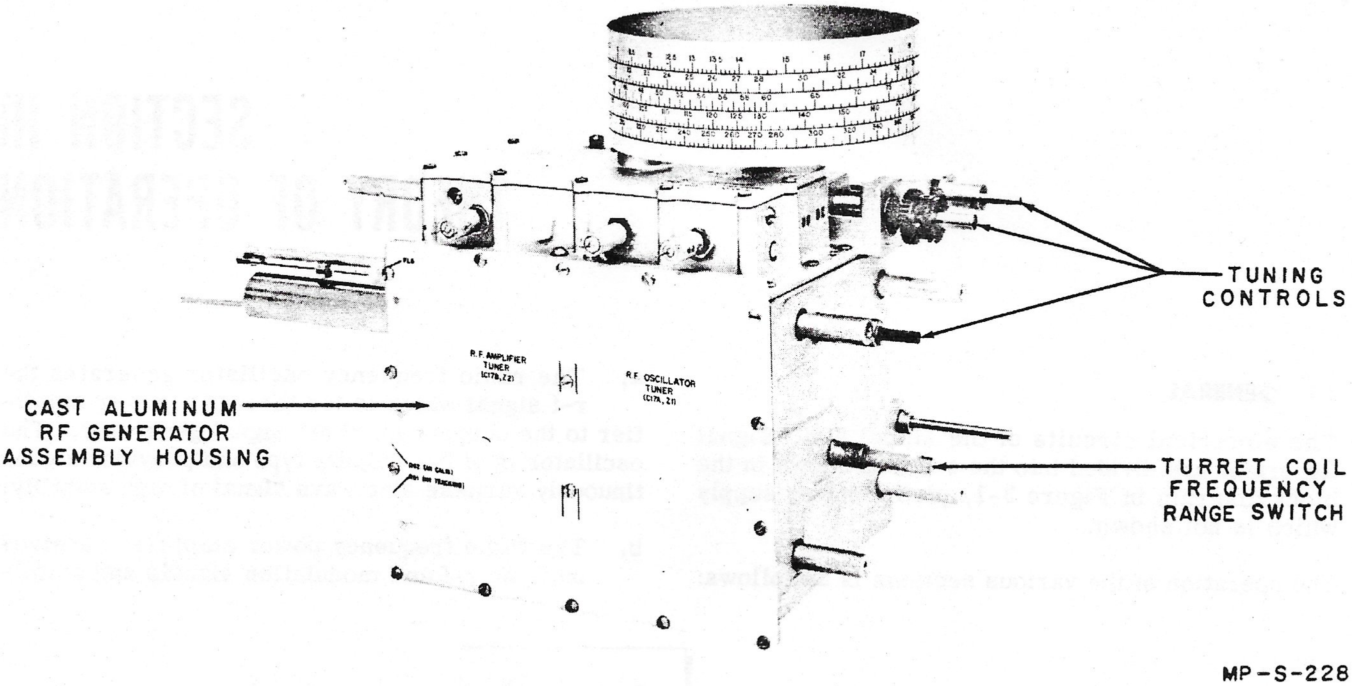
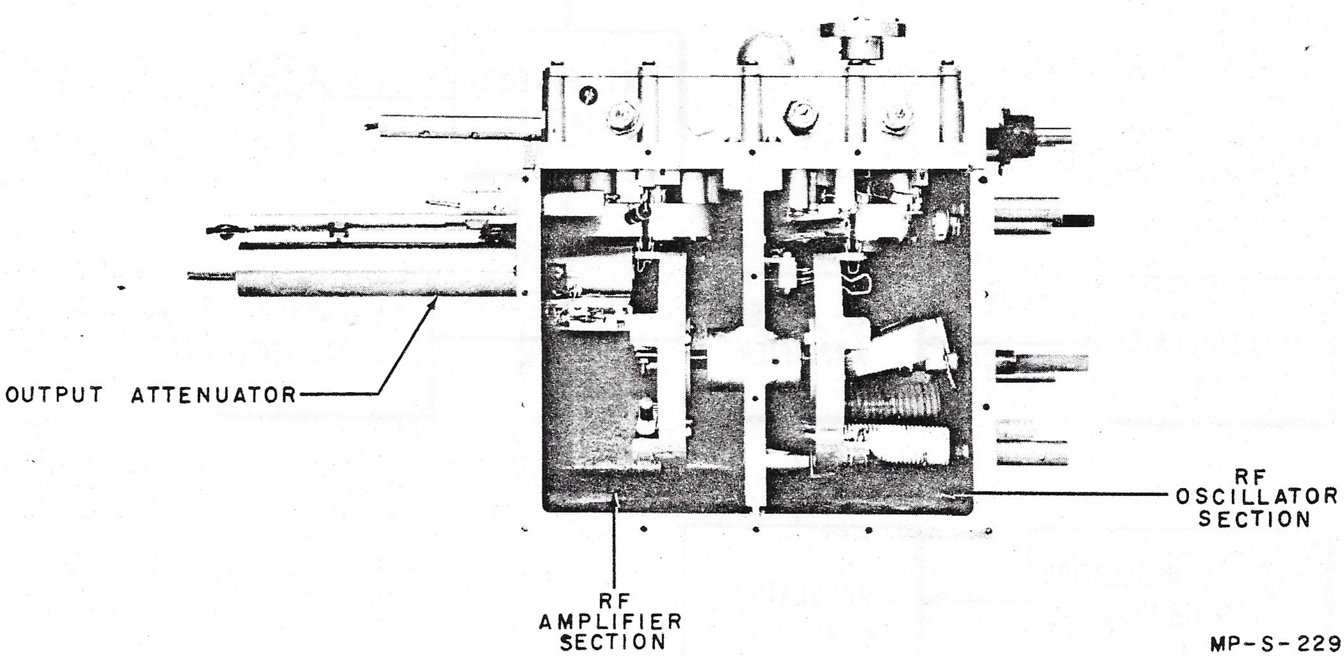


Figure 3-1. Block Diagram for Model 608C



a) Cover Plate Attached



b) Cover Plate Removed

Figure 3-2. R-F Generator Assembly

fies the r-f energy for application to the output attenuator. The r-f amplifier also receives variable bias from the modulator which permits adjustment of the power level fed to the output attenuator.

c. The output power monitor samples the r-f energy fed to the output attenuator and indicates the power and voltage level on a front panel meter.

d. The output attenuator obtains monitored r-f energy from the power amplifier, applies the selected degrees of attenuation, and conducts the energy to the front panel output jack.

e. The internal modulation oscillator generates either a 400 or 1000 cycle-per-second sine wave for application to the modulation system.

f. The modulator receives all signals for application to the r-f power amplifier and also supplies variable bias to the r-f amplifier for control of the r-f output level.

g. The modulation-measuring circuits receive detected modulation from the r-f power monitor, amplify and rectify it, and indicate the modulation percentage directly on a front panel meter.

3-2 R-F GENERATOR ASSEMBLY

The r-f generator assembly, shown in Figure 3-2, is the heart of the Model 608C, generating the r-f energy that is delivered to the external load. This assembly houses an MOPA circuit consisting of a Colpitts oscillator, power amplifier, and a piston-type output attenuator. To hold both radiated and conducted r-f leakage to a minimum, the radio frequency circuits of the generator are enclosed in a cast aluminum housing, with all electrical connections to the internal circuits being made through special r-f filters.

3-3 RADIO FREQUENCY OSCILLATOR

The radio frequency oscillator generates a sine wave signal from 10 to 480 megacycles in five frequency bands, each band having approximately a 2:1 frequency range. A type 5675 "pencil" triode tube is used in a Colpitts circuit tuned by a precision split-stator capacitor and five separate r-f transformers, L1 through L5. The tuning capacitor, which is specially constructed for high stability and resetability, consists of two stator sections connecting to the grid and plate of the oscillator tube and a floating rotor which meshes equally between the two stators. The tuning capacitor assembly, mounted inside and at the top of the oscillator tuning compartment in the generator housing, is driven by a ball-bearing mounted worm drive through the top of the housing.

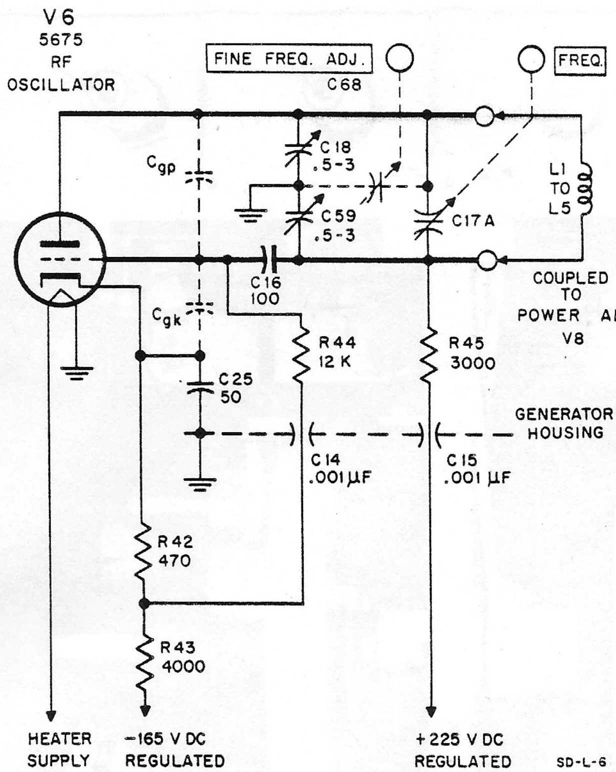


Figure 3-3. Schematic Diagram of Radio Frequency Oscillator

The tuned inductors for the A, B, and C bands are precision wound under tension on ceramic forms while for the D and E bands the inductors consist of silver-plated Invar bar loops. The inductors are mounted on a revolving turret actuated by the FREQUENCY RANGE selector. As the turret is rotated, the desired coil is positioned in the tuned circuit just below the oscillator tuning capacitor, connections being made through large silver contacts mounted directly on the bottoms of the two stators of the tuning capacitor. Both ends of the tuning inductor and capacitor are at r-f and d-c potential, with no part of this circuit grounded.

The fine frequency tuner consists of a small metal disk mounted off center at the end of a bakelite control shaft (see Figure 3-4). The shaft is mounted level with the oscillator tuning capacitor about 1/2" away. As the shaft is turned, the disk moves closer or farther away from the tuning capacitor to increase and decrease the capacity in the tuned circuit. The change occurs over 180° rotation of the knob. When

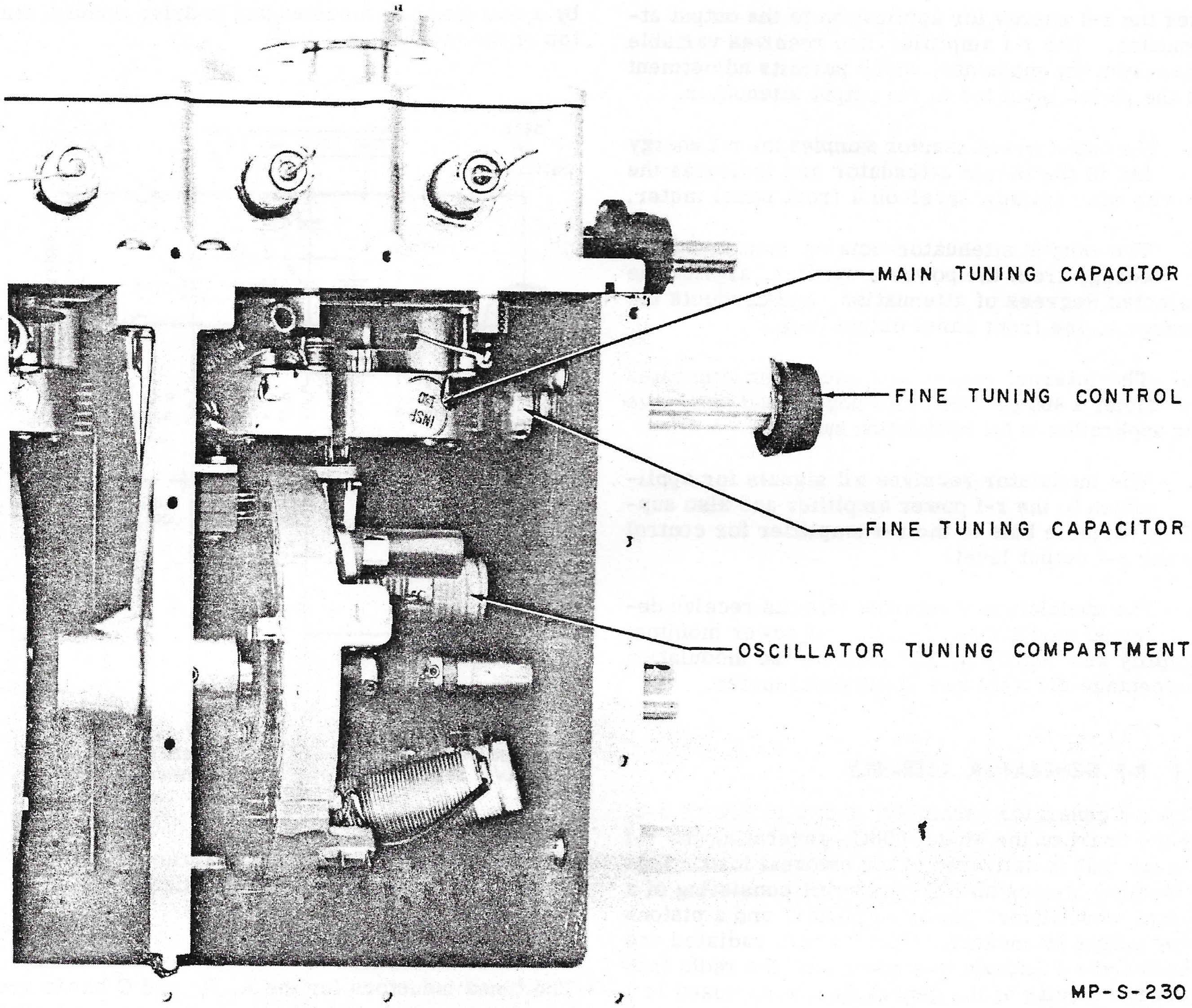


Figure 3-4. R-F Oscillator Compartment showing Fine Frequency Tuning Control

the dot points to the left, the vernier capacity is maximum; when the dot points to the right the capacity is minimum. The accompanying figure shows the vernier device as it is mounted within the oscillator tuning compartment of the r-f generator assembly.

The circuit diagram for the oscillator is shown in Figure 3-3. The oscillator tube, V6, is operated across the -165 volt and +225 volt supplies with considerable series resistance to limit the maximum plate current that can flow. The plate is series-fed through a 3000-ohm resistor, R45, which also serves to isolate the tuned circuit from r-f ground at C15, while the cathode is returned to -165 volts through R42 and R43. Cathode by-pass capacitor C25 is actually part of the tube mounting plate and is not visible when the plate is in position. R42 prevents resonance in the cathode lead; R43 in conjunction with R45 limits the maximum plate current that can flow through V6. Bias for the control grid is obtained across grid leak resistor R44, which under usual conditions develops approximately 70 volts of bias. C16 couples the tuning coil to the grid, the drive being determined by the ratio of grid-plate to grid-cathode impedance. These impedances consist partly of inter-electrode capacity, shown as dotted components in the partial schematic diagram, and largely of lumped constants in the tuned circuit. The grid-plate capacity is shunted by the tuned cir-

cuit and a small trimmer capacitor C18, while the grid-cathode capacity is shunted by trimmer capacitor C59. C18 sets the minimum capacity of the tuned circuit and is used to adjust the high-frequency limit of all bands when the oscillator tube is replaced. C59 is an additional adjustment usually set for minimum capacity and requiring no readjustment. This capacitor has minor effect on the grid drive at the high frequency ends of the bands and is usually set for maximum drive. The inductances of the tuned inductors is variable over a small range by adjusting a single shorted turn on each coil for the A, B, and C bands and by adjusting the size of the single loops for the D and E bands. These adjustments are used at the factory to set the low-frequency limit of each frequency band.

Heater voltage for the oscillator tube is obtained from a transistor circuit operating on regulated voltage which supplies d-c heater power. All power to the oscillator tube is brought through the housing by special filters having high attenuation of radio frequencies to prevent conduction of the r-f energy outside the instrument. The entire oscillator circuit is contained in the cast aluminum r-f generator assembly shown in Figure 3-2a. The tuned circuits are located in a lower front compartment, the other circuits in a tube compartment above. An inside view of the r-f generator assembly is shown in Figure 3-2b. The oscillator tube is mounted through the top of the tuning compartment so that the grid and plate elements project through the top plate into the tuning compartment, while the heater and cathode elements remain above the top plate. Mounting facilities are contained in the upper compartment, and the tube may be replaced from the upper compartment without entering the tuning compartment.

3-4 RADIO FREQUENCY POWER AMPLIFIER

A loosely coupled secondary winding on each of the oscillator coils couples r-f energy from the oscillator to the radio frequency power amplifier, V8, which amplifies the energy for application to the output attenuator. The circuit consists of a 5876 "pencil" triode connected as a grounded-grid, cathode-modulated amplifier. The plate circuit of the amplifier is tuned in the same manner as the oscillator, with a similar split-stator capacitor and five untapped coils mounted on a revolving turret. The amplifier tuning capacitor is ganged with the oscillator capacitor by a double-ended worm drive. The amplifier capacitor is provided with a mechanical

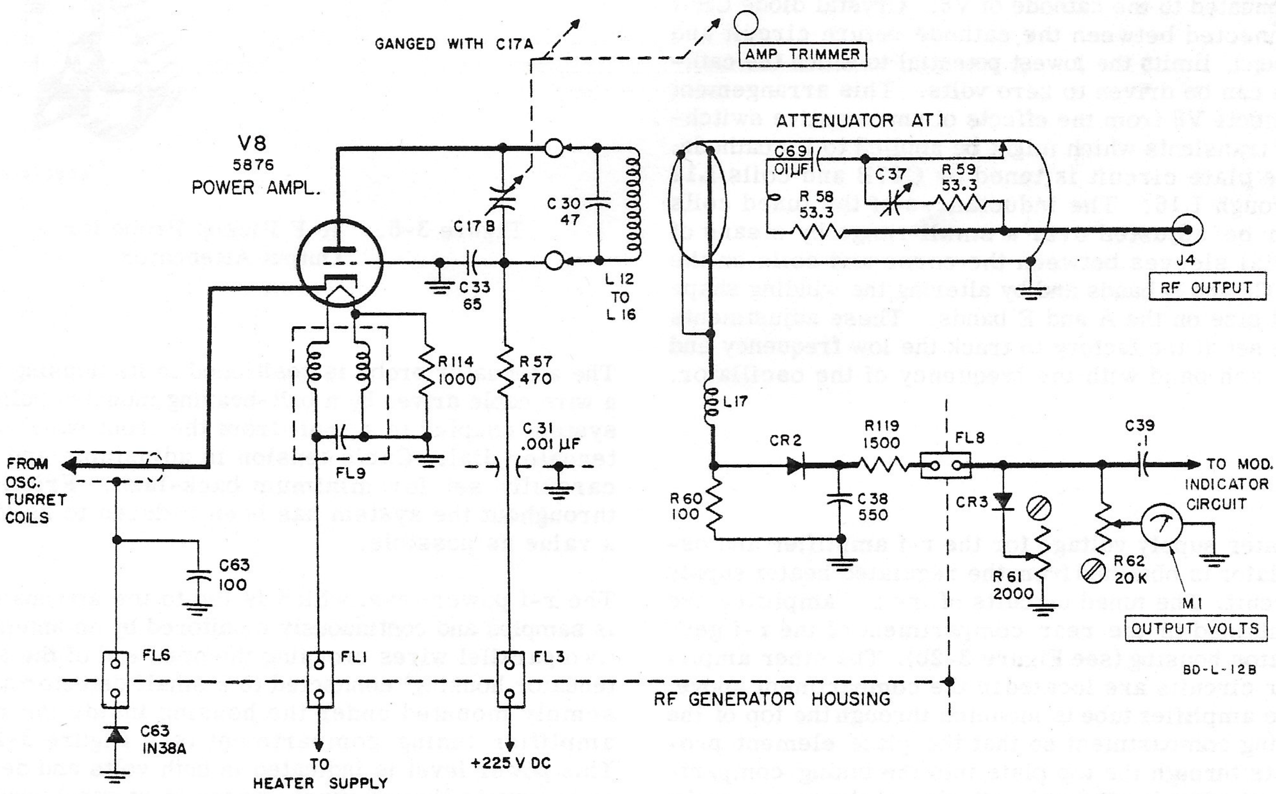


Figure 3-5. Schematic Diagram of Radio Frequency Power Amplifier

linkage, controlled from the front panel, to shift the rotor plates from their normal tracking position with respect to the oscillator. This control allows the amplifier tuning to be trimmed for maximum output at all frequencies.

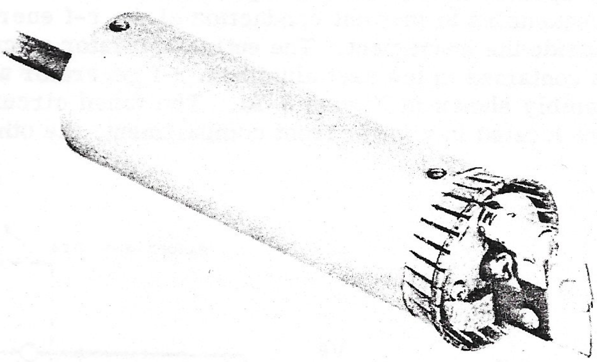
The coil mounting turret is also ganged with that of the oscillator. Tuned coils are wound with copper wire on teflon forms, and the coil in use is so located to be inductively coupled to the output attenuator probe.

The circuit diagram for the r-f amplifier is shown in Figure 3-5. The power amplifier tube is operated across the -165 and +225 volt supplies. The plate is series-fed from the +225 volt supply through decoupling filter R57 and C33. The cathode is returned through resistors R35 and R36 to the -165 volt supply. R36 matches the higher impedance of the cathode circuit of V5 to the lower impedance of the cathode circuit of V8, while R35 is the cathode bias-developing resistor. R35 is also the cathode load resistor for control tube V5, and the bias voltage developed across R35 is largely controlled by the current established in V5. The modulating signal is also developed across R35 and with the bias voltage is fed through filter FL6 to the cathode of V8. Filter FL6 cuts off sharply at approximately 6 megacycles but allows the modulation signal to pass unattenuated to the cathode of V8. Crystal diode CR7, connected between the cathode return circuit and ground, limits the lowest potential to which the cathode can be driven to zero volts. This arrangement protects V8 from the effects of any negative switching transients which might be applied to its cathode. The plate circuit is tuned by C17B and coils L12 through L16. The inductances of the tuned coils can be adjusted over a small range by means of metal sleeves between the cores and coils on the B, C, and D bands and by altering the winding shape and size on the A and E bands. These adjustments are set at the factory to track the low frequency end of each band with the frequency of the oscillator.

Heater supply voltage for the r-f amplifier and oscillator is obtained from the regulated heater supply circuit. The tuned circuits of the r-f amplifier are contained in the rear compartment of the r-f generator housing (see Figure 3-2b). The other amplifier circuits are located in the compartment above. The amplifier tube is mounted through the top of the tuning compartment so that the plate element projects through the top plate into the tuning compartment. The heater and cathode elements are in the upper compartment and the tube may be replaced without entering the tuning compartment.

3-5 OUTPUT ATTENUATOR AND R-F POWER MONITOR

To extract power from the r-f power amplifier, a piston attenuator is used. The housing for the attenuator projects through the rear of the r-f generator housing and terminates, open-ended, close to the r-f amplifier plate circuit inductor (see Figure 3-2b). Figure 3-6 shows the front view of the attenuator probe removed from the attenuator housing. The non-resonant, single-turn, pickup loop at the end of the attenuator probe couples energy to an impedance-matching network, C37, R58, and R59, mounted on the face of the probe and through a section of double-shielded coaxial cable to the RF OUTPUT jack. Capacitor C37 is actually a movable slug in the probe body. It allows minor adjustment of the internal impedance of the generator so that a minimum standing wave ratio is obtained when the output jack is terminated in a 50-ohm load.



608C-A-2

Figure 3-6. R-F Pickup Probe for Output Attenuator

The attenuator probe is positioned in its housing by a wire cable driven by a ball-bearing mounted pulley system coupled to a shaft from the front panel attenuator dial. Cable tension is adjustable and is carefully set for minimum back-lash. Friction throughout the system has been reduced to as low a value as possible.

The r-f power level which is fed to the attenuator is sampled and continuously monitored by an antenna (two parallel wires crossing the open end of the attenuator housing) connected to a small detector assembly mounted under the housing inside the r-f amplifier tuning compartment (see Figure 3-2). This power level is indicated in both volts and decibels, over a limited range, on the front panel power level meter. A calibration mark on the meter marked SET LEVEL establishes a correct amount of power

fed into the attenuator housing for direct reading of the output attenuator dial calibration.

Radio frequency energy is coupled from the power monitoring antenna to a detector through L17, a small coil used to adjust the frequency response of the detector circuit. Crystal diode CR2 with return resistor R60 rectifies the radio frequency energy and produces a d-c voltage equal to half the peak-to-peak r-f voltage. C38 and filter FL8 remove the remaining r-f component and couple the d-c voltage to a compensating network, CR3 and R61. FL8 is specially designed to attenuate all radio frequencies above approximately 2 megacycles and to pass all frequencies below that frequency with little or no attenuation. CR3 corrects for non-linearities in detector CR2 when the r-f signal level is low and detection takes place in the non-linear region of the diode. The degree of compensation is set by potentiometer R61 and is adjusted to obtain accurate down-scale readings on the front panel power level meter. M1 is calibrated to indicate the rms value of the r-f output signal. Potentiometer R62 adjusts the sensitivity of the meter and is set at the factory with accurate vhf power measuring equipment.

3-6 MODULATOR SECTION

The purpose of the modulator section is threefold: to generate 400- and 1000-cycle sine waves for internal modulation of the generator; to amplify all modulation signals for application to the r-f power amplifier; to control the power level obtained from the r-f amplifier for all types of operation by varying the bias on the r-f amplifier tube. The modulator consists of a resistance-tuned oscillator, V2, shown in Figure 3-7, a limiter and single-stage video amplifier, V1 and V3, shown in Figure 3-8; and a cathhode follower output stage and output level control tube, V4 and V5, shown in Figure 3-9. The modulator circuits are located along the upper portion of the right side chassis; the oscillator on the bottom portion.

The modulation oscillator is a resistance-tuned sine wave generator of the Wein Bridge type. Basically, the circuit consists of a two-stage resistance-coupled amplifier which is caused to oscillate by the use of a frequency-selective positive feedback circuit. At the resonant frequency there is no phase shift in the

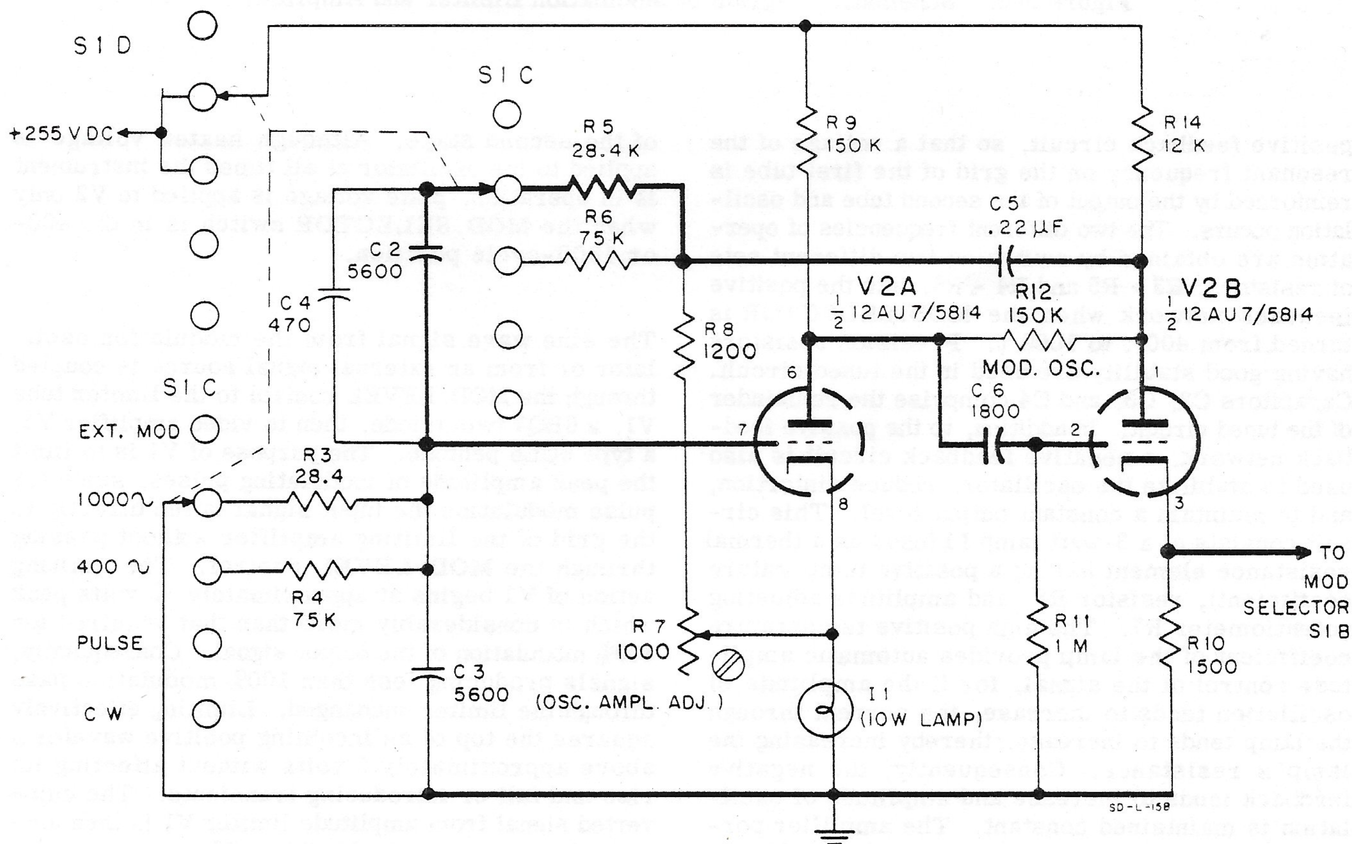


Figure 3-7. Schematic Diagram of Internal Modulation Oscillator

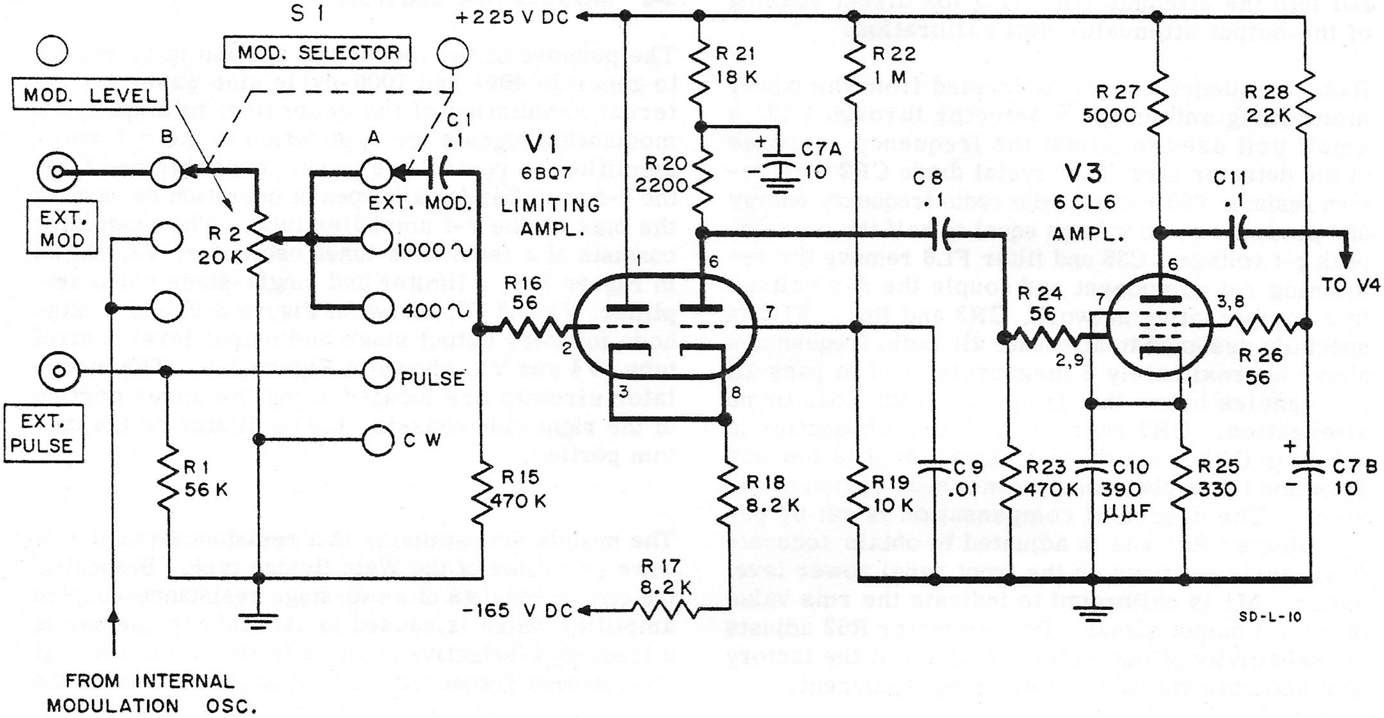


Figure 3-8. Schematic Diagram of Modulation Limiter and Amplifier

positive feedback circuit, so that a voltage of the resonant frequency on the grid of the first tube is reinforced by the output of the second tube and oscillation occurs. The two different frequencies of operation are obtained by switching two different sets of resistors, R3 - R5 and R4 - R6, into the positive feedback network when the MOD. SELECTOR is turned from 400 ∿ to 1000 ∿. Precision resistors having good stability are used in the tuned circuit. Capacitors C2, C3, and C4 comprise the remainder of the tuned circuit. In addition, to the positive feedback network, a negative feedback circuit is also used to stabilize the oscillator, reduce distortion, and to maintain a constant output level. This circuit consists of a 3-watt lamp I1 (used as a thermal resistance element having a positive temperature coefficient), resistor R8, and amplitude adjusting potentiometer R7. The high positive temperature coefficient of the lamp provides automatic amplitude control of the signal, for if the amplitude of oscillation tends to increase, the current through the lamp tends to increase, thereby increasing the lamp's resistance. Consequently, the negative feedback tends to increase and amplitude of oscillation is maintained constant. The amplifier portion consists of two medium-mu triodes, V2A and B, in a conventional resistance-coupled circuit with the output voltage being obtained from the cathode of the second stage. Although heater voltage is applied to the oscillator at all times the instrument is in operation, plate voltage is applied to V2 only when the MOD. SELECTOR switch is in the 400- or 1000-cycle position.

The sine wave signal from the modulation oscillator or from an external signal source is coupled through the MOD. LEVEL control to the limiter tube V1, a 6BQ7 twin triode, then to video amplifier V3, a type 6CL6 pentode. The purpose of V1 is to limit the peak amplitude of modulating pulses, since for pulse modulation the input signal is fed directly to the grid of the limiting amplifier without passing through the MOD. LEVEL control. The limiting action of V1 begins at approximately +2 volts peak which is considerably more than that required for 100% modulation of the output signal. Consequently, signals producing less than 100% modulation pass through the limiter unchanged. Limiting effectively squares the top of an incoming positive waveform above approximately 2 volts without affecting its rise and fall or introducing transients. The uninverted signal from amplitude limiter V1 is then amplified approximately 18 db by V3, a resistance-coupled 6CL6 pentode voltage amplifier, and coupled to output cathode follower V4.

From the limiter and amplifier, the modulating signal is fed to output cathode follower V4, a triode-connected type 6CL6 pentode. For sine wave modulation the signal from the cathode of V4 is coupled through switches S1E and S1F to the grid of the output level control tube V5 and superimposed on the variable bias voltage. The cathodes of both V5 and the r-f power amplifier V8 are connected together and returned to the -165-volt supply through resistor R35. Any signal placed on the grid of V5 is therefore directly coupled from the cathode of V5 to the cathode of the r-f power amplifier V8. The d-c voltage level established at the cathodes of the two tubes is determined largely by the current flowing in V5. The current in V5 is controlled by the dual potentiometer voltage divider, R34, R37, and R40, in the grid circuit. The cathode bias for V8, and consequently the r-f output power, is varied by front panel output level potentiometers R37A and R37B.

For pulse modulation the cathode of V4 is connected by the MOD. SELECTOR switch directly to the cathode of V5. The additional current drawn by V4 through common cathode resistor R35 produces a sufficiently high bias to cut off the r-f amplifier and reduce the r-f output to zero. The modulating pulses are not applied to the grid of V5, and it now serves only to control the peak level of the r-f output pulse. Negative modulating pulses (the positive input pulse having been inverted in V3) at the grid of V4 cut off V4 and allow the cathode potential to return to the level set by V5 which establishes an r-f output level equal to the cw level as indicated on the output level meter. An r-f output pulse having an envelope shaped like the modulating pulse is then formed.

3-7 MODULATION-MEASURING CIRCUITS

The modulation-measuring circuits in the 608C indicate any modulation of the rf output signal between 0 and 100%. These circuits consist of a stabilized wideband amplifier and a bridge-type metering circuit. The measuring circuit reads the peak value of the rectified modulation signal and is accurate for all waveforms. The meter is calibrated to indicate the percent modulation of a given amount of rf carrier power. The amount is established by SET LEVEL on the output level meter and is accurate for all settings of the output attenuator.

The circuit diagram for the stabilized amplifier, shown in Figure 3-10, consists of two conventional resistance-coupled type 6AH6 pentodes, V18 and V19. The circuit is stabilized by negative feedback

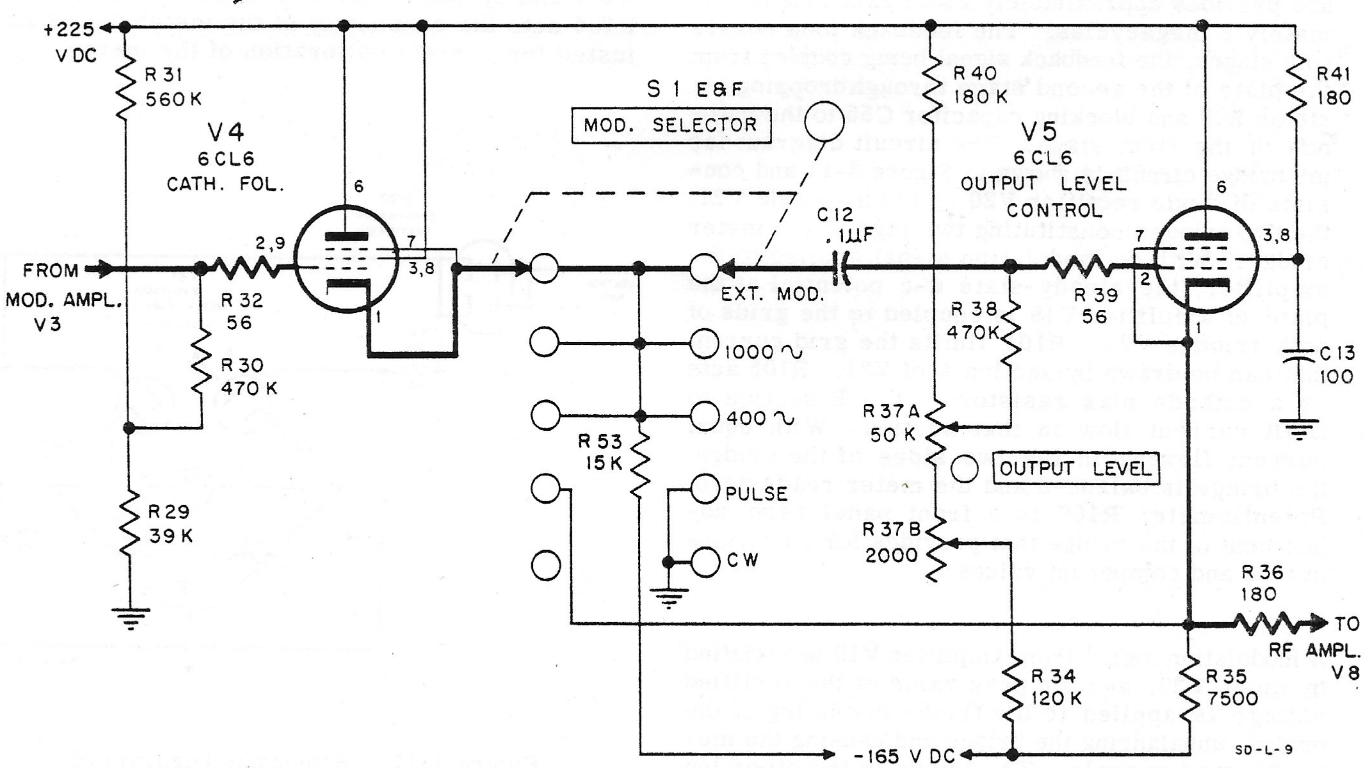


Figure 3-9. Schematic Diagram of Modulation Cathode Follower and Output Level Control Stages

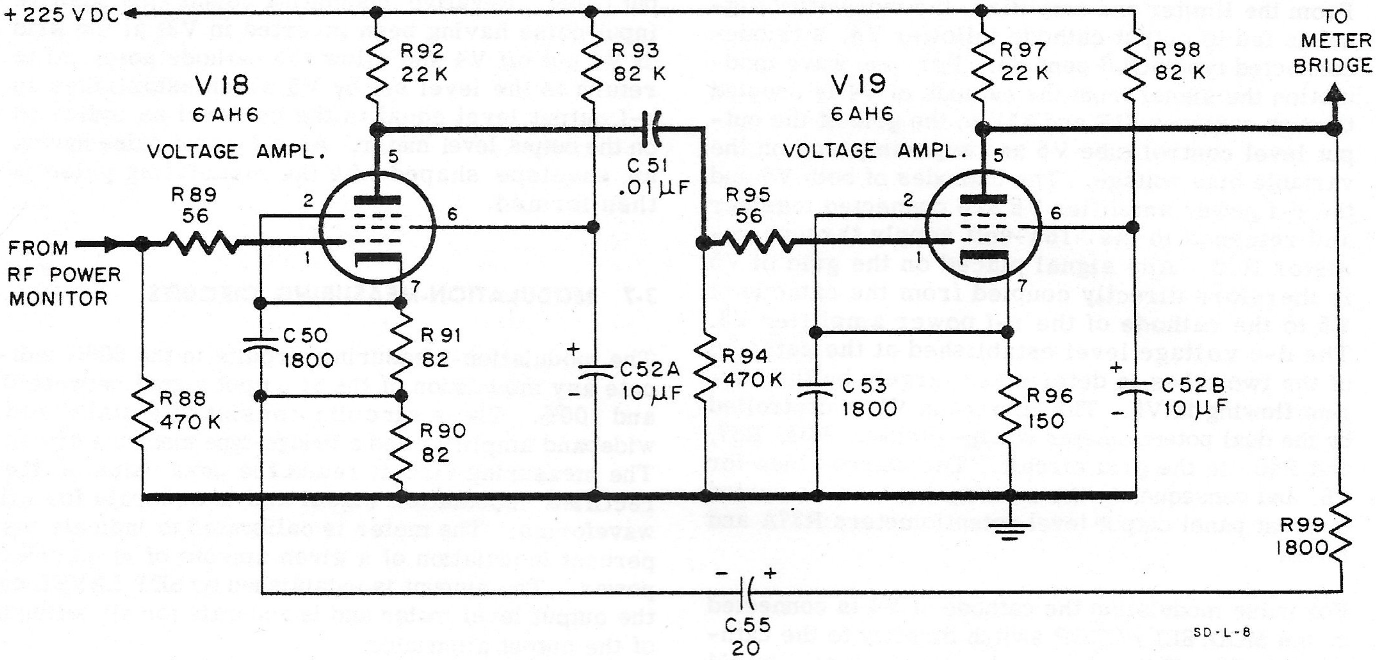


Figure 3-10. Schematic Diagram of Modulation Indicator Amplifier

and provides approximately 22 db gain to approximately 2 megacycles. The feedback loop covers both stages, the feedback signal being coupled from the plate of the second stage through dropping resistor R99 and blocking capacitor C55 to the cathode of the first stage. The circuit diagram for the bridge circuit is shown in Figure 3-11 and consists of diode rectifier V20 and twin-triode V21, the two triodes constituting two legs of the meter bridge. With no modulation signal applied to the amplifier, the steady-state d-c potential at the plate of amplifier V19 is coupled to the grids of both triodes V21. R101 limits the grid current that can be drawn by section A of V21. R105 acts as a cathode bias resistor in the B section to limit current flow in that section. With equal current flowing in the two sides of the bridge, the bridge is balanced and the meter reads zero. Potentiometer R106 is a front panel zero adjustment of the bridge that provides for variations in tube and component values.

A modulation signal from amplifier V19 is rectified by diode V20, and the peak value of the rectified voltage is applied to the triode in one leg of the bridge, unbalancing the bridge and causing the meter to read upscale. The triode in the other leg of the bridge is unaffected by the modulation signal as the signal is filtered out by the resistor R101 and by-pass capacitor C58. Potentiometer R104 sets the sensitivity of the meter and is adjusted for correct calibration of the meter.

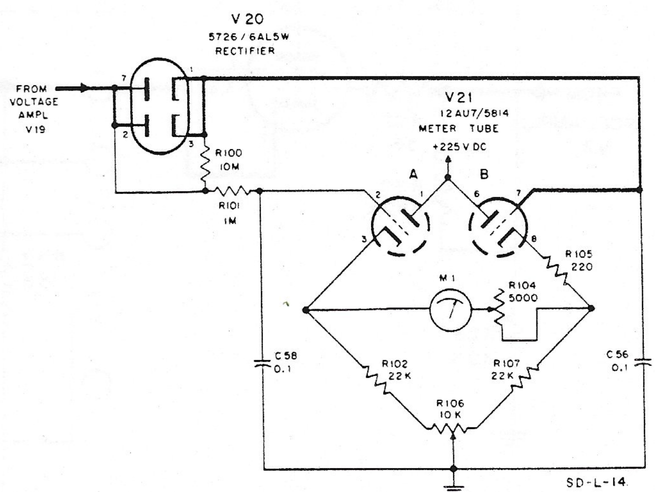


Figure 3-11. Schematic Diagram of Modulation Meter Bridge and Rectifier

3-8 POWER SUPPLY

The power supply for the signal generator consists of two electronically regulated high voltage supplies, one providing -165 volts dc, the other providing +225 volts dc, with the chassis at zero potential. Each regulator is supplied from a full-wave bridge-type silicon rectifiers with a separate high voltage winding on the power transformer. The power transformer also supplies a-c voltage for all electron tube heaters except the r-f oscillator and power amplifier. The primary winding of T1 is divided into two parts and may be operated in series for 230-volt lines or in parallel for 115-volt lines. The output of each regulated supply is adjustable by screwdriver adjusted potentiometers R80 and R71 on the rear instrument chassis. The +225-volt supply uses the -165 supply for a reference voltage; consequently, a change in the -165 volts also affects the output from the +225-volt supply.

Since the two regulated power supplies are identical in operation, only the -165-volt supply will be discussed. Figure 3-12 shows the complete schematic for both supplies. V14, V15, and V16 constitute the voltage regulator circuit for the -165-volt supply. V15 is a constant-voltage tube which provides a reference bias for voltage amplifier V14. V16A operates as the regulator tube (or variable resistor) controlled by the voltage at the grid of V14. If the regulated output from the cathode of V16A tends to increase, the voltage at the grid of V14 tends to in-

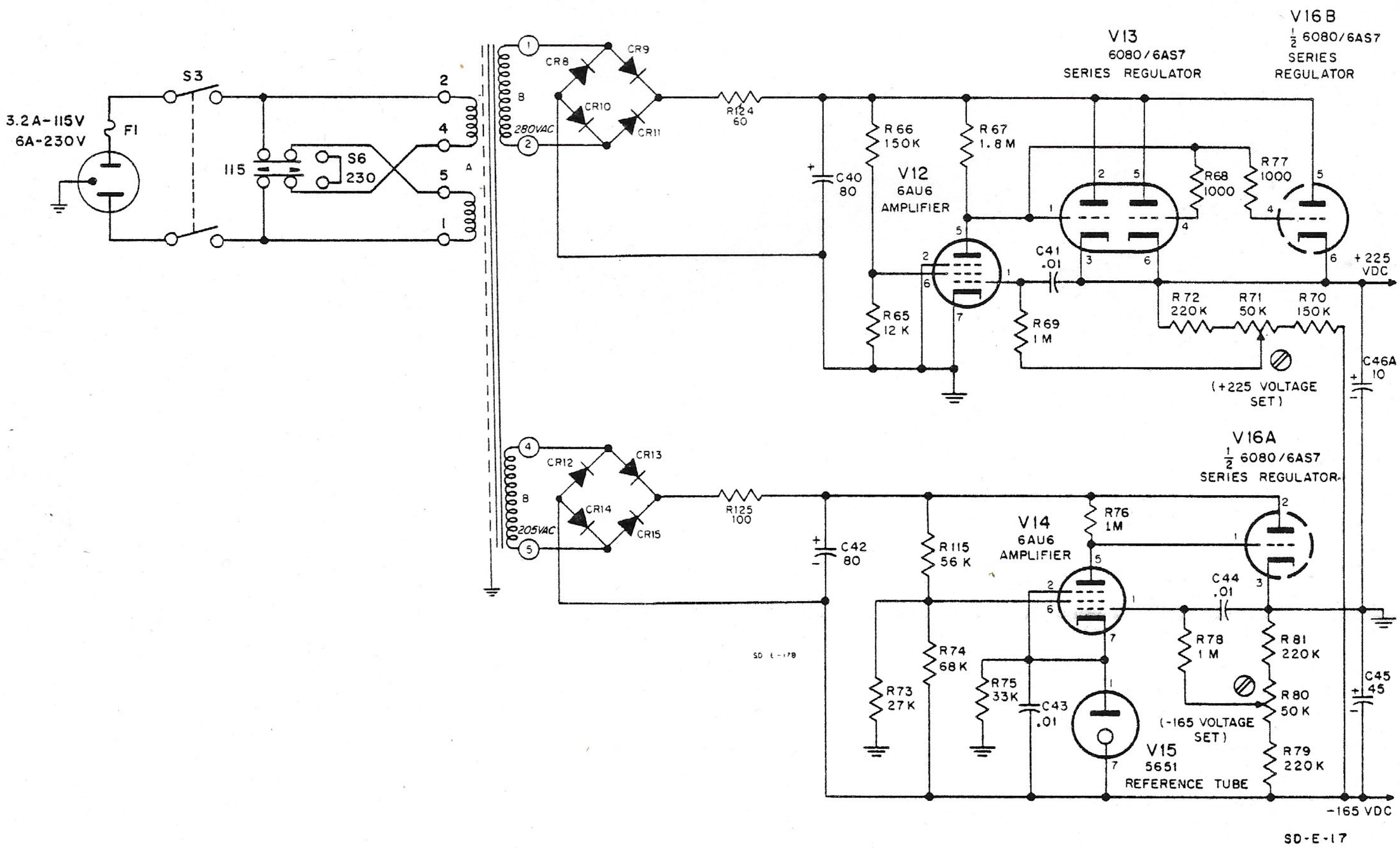


Figure 3-12. Schematic Diagram of Regulated Power Supplies

crease, causing V14 to draw more current. This lowers the plate voltage of V14 and consequently the grid voltage of V16A, resulting in a greater plate resistance for V16A. The greater plate resistance causes a greater voltage drop across V16A, instantaneously compensating for the increased voltage at its cathode and resulting in a substantially constant voltage output.

If the regulated output tends to decrease, the reverse of the above action occurs, also tending to maintain the cathode voltage constant. Ripple in the output voltage is coupled to the grid of V14 by capacitor C44, while slower variations in the d-c level are fed to the grid of V14 through voltage divider R79, R80, and R81. The bias of V14, and thus the output voltage level from V16A, is determined by the setting of R80.

The operation of the +225-volt supply is identical; but due to additional current requires (approximately 150ma), three regulator tubes (V13A and B, V16B) must be used in parallel. The reference voltage for the +225-volt supply is obtained directly from the output of the -165-volt supply.

3-9 RF TUBE HEATER SUPPLY

Constant amplitude heater voltage is supplied to V6 and V8 by a regulated supply consisting of CR16 through CR19, Q1, and reference diode CR20. Diode CR20 supplies the base of Q1 with a constant voltage. Since the transistor configuration is an emitter follower, the emitter remains at the same potential (+0.3V) as the base.

SECTION IV
MAINTENANCE

4-1 INTRODUCTION

Section IV contains instructions for preventive maintenance, trouble localization, tube replacement procedures, and internal adjustments in the Model 608C Signal Generator. To assist with servicing the signal generator, a trouble shooting chart and circuit-tracing block diagram are also included. At the end of this section will be found additional locating illustrations, tube socket voltage and resistance diagrams, and the schematic diagram for the complete equipment.

The following information can be found in this section:

4-2 CABINET REMOVAL

To remove the instrument chassis from the cabinet, loosen the four captive screws on the rear of the cabinet and pull the instrument from its cabinet by the guard-rail handles. The rear of the instrument chassis is supported on steel rollers and should move freely from the cabinet.

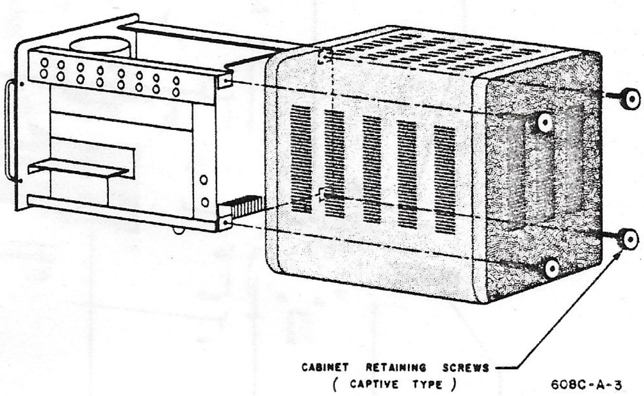


Figure 4-1. Cabinet Removal Diagram

4-3 PERIODIC CHECKS AND ROUTINE CARE

PREVENTIVE MAINTENANCE -

Reasonable care in transporting, handling, and operating the 608C Signal Generator will help to prolong its useful life and minimize trouble. No special checks are required other than a general alertness for the effects of misuse, loose controls, condition of cables and connectors, and possible damage that may be evident in its general appearance. A limited but useful operational check may be performed without the use of external equipment by operating the equipment as instructed in paragraph 2-6, indications of normal operation being read from the two front panel meters. If the equipment has been subjected to unusual conditions - excessive moisture, dust, heat, vibration, etc. - it is suggested that the instrument be removed from the cabinet and inspected for dirt or moisture accumulation, loosened components, or any possible sign of damage. Forced air under medium pressure is recommended for dusting and drying, although care must be taken not to vary the settings of the internal adjustment potentiometers and capacitors during the process. When tightening nuts and screws,

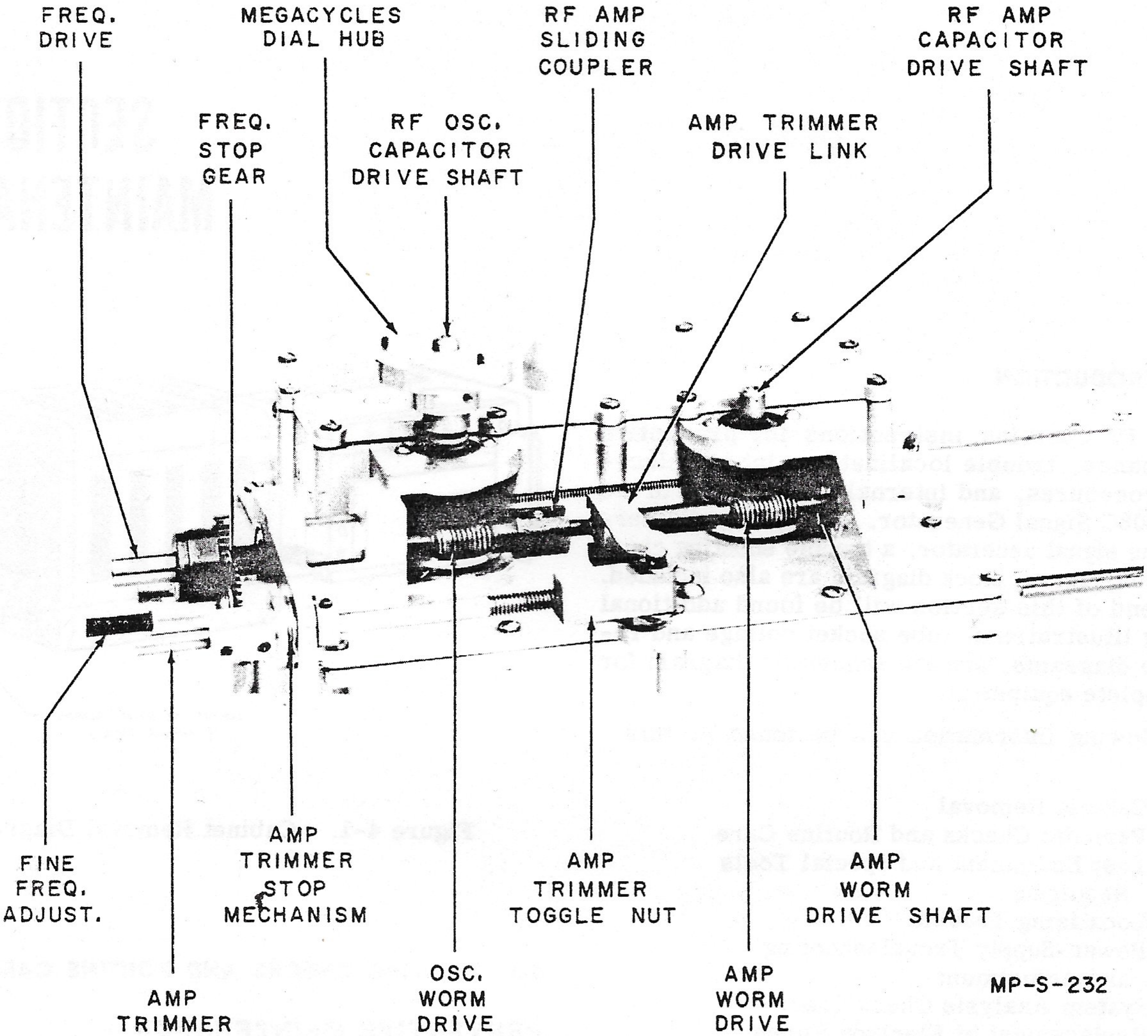


Figure 4-2. R-F Tuner Drive Mechanism

various degrees of pressure are required depending on the strength of the material and weight which is supported. Avoid overtightening.

LUBRICATION —

The 608C is thoroughly lubricated at the factory. The gears in the r-f generator housing operate at slow speeds and transmit negligible power. Fully shielded ball bearings are used in many applications and require no subsequent attention. Ball bearings that are not fully shielded require only light machine oil. The two worm gears used in the tuning capacitor drive should be cleaned and lubricated approximately every sixty days. If cleaning and relubrication are needed after prolonged use of the instrument, excessive dust accumulation, or drying of lubricant, reference to the following chart and Figures 4-2 and 4-6 will assist with renewing the lubricants at various points on the r-f generator assembly. The two worm gears used in the tuning capacitor drive are lubricated with "Moly Lubricant". All remaining sleeve bearings and rubbing surfaces - including the small pulleys used in the attenuator drive system - are lubricated with a light synthetic oil such as Shell Tonna Oil G. The bakelite RANGE SELECTOR drive shaft and the attenuator drive shaft - not shown in the illustration - require lubriplate grease #2 where they enter the r-f generator housing. In all cases, AVOID OVER-LUBRICATION or use of light weight oil on worm gears.

LUBRICATION CHART

Lubrication Point (Figures 4-2, 4-6)	Lubricant
Oscillator and amplifier worm gears	"Molykote(type Z)"
AMP TRIMMER Stop mechanism Toggle nut Drive AMP Worm drive shaft Sliding coupler Attenuator Pulleys Drive shaft front panel bearing	Light machine oil
Housing guide slot	Lubriplate #2
Note: In all cases, avoid over-lubrication.	

4-4 TEST EQUIPMENT AND SPECIAL TOOLS REQUIRED

A special wrench for removing r-f power amplifier tube V8 is included with the signal generator and is located inside the instrument cabinet mounted beside the r-f generator housing. Test equipment recommended for servicing the signal generator is listed in Table 4-1.

4-5 LOCALIZING TROUBLE

The first step in correcting any trouble which may occur in the signal generator is to isolate the section of the equipment that causes the trouble. The various circuits of the 608C occupy easily defined areas and offer very good circuit accessibility. Figures 4-10 and 4-11 will prove helpful in locating circuits within the r-f generator housing. Isolation of a circuit failure is best accomplished by considering the basic sections shown in the block diagrams in Figures 2-2 and 3-1.

4-6 POWER SUPPLY TROUBLESHOOTING AND ADJUSTMENT

A systematic trouble-localization procedure is outlined in Table 4-2. The typical values given were obtained with a reliable 5000-ohm/volt multimeter.

When the correct voltage reading (shown in the second column) is obtained, the particular circuit tested may be assumed to be operating properly. The condition which results in an incorrect or unstable voltage indication should be corrected as instructed in the service note in the third column. Components are identified in the Figures referenced in the first column.

All voltages are measured between the indicated point and chassis ground. When possible, use a variable voltage line transformer to adjust the line voltage from 105 to 125 volts while measuring the power-supply voltages. Marginal operation is quickly detected in this manner since the regulated voltages should remain stable during such line voltage changes. The power-supply circuit is shown in block diagram form in Figure 4-3.

4-7 SYSTEM ANALYSIS CHECK CHART

Table 4-3, a system analysis check chart, lists the test points and the measurement data taken at each point.

Measurements made at these test points provide positive means for isolating a source of trouble to a small circuit area since the measurement data may be analyzed to determine the type of failure. For example, insufficient gain through an amplifier normally indicates a weak tube, distortion may indicate a gassy tube, shorted coupling capacitor, faulty resistor, etc. A faulty resistor can be located by voltage and/or resistance measurements at the tube socket terminals and by comparing the readings with those given in the tube-socket voltage-resistance diagrams at the rear of the manual. A shorted capacitor usually may be located by measuring the resistance across it; low or zero resistance indicates the capacitor is shorted. An open capacitor may be located by substitution.

Unless otherwise noted, the values given in the chart were measured between indicated point and ground with a 20,000-ohm/volt multimeter. When measurements should be made with a high-impedance voltmeter or a meter with greater sensitivity, the requirement is noted.

To start, set the generator for 100-mc CW operation and an output level of 0 dbm, then shift controls as instructed in the chart. Follow steps in order given: some steps assume satisfactory indications were obtained from previous measurements. Initial control settings:

Power Switch	ON
MOD SELECTOR	CW
FREQUENCY RANGE	D
FREQ	100
MOD LEVEL	minimum
AMP TRIMMER	Set for maximum output
OUTPUT LEVEL	Set for SET LEVEL reading on OUTPUT VOLTS meter
ATTEN	0 dbm
XTAL CAL GAIN	maximum

OUTPUT LEVEL should be adjusted to SET LEVEL unless otherwise specified

Table 4-1. Recommended Test Equipment

Instrument Type	Critical Specifications	Application	Model
General Purpose Multimeter	DC Voltage Range: 0.1-360V Voltage Accuracy: ±2% of reading Resistance Range: 100 megohms Input Impedance: 100 megohms	General purpose voltage and resistance measurements	hp 410B or hp 412A
Clip-On Milliammeter	Range: 20-200 ma Accuracy: ±0.1 ma	System analysis checks	hp 428A/B
AC VTVM	Range: 0.01-6.5V Accuracy: ±2% of reading Input Impedance: 10 megohms	High impedance and/or low level AC measurements	hp 400D
Crystal Calibrator	Range: 10 to 480 mc Accuracy: 0.1%	Main frequency calibration	Measurements Corp Model 111
Oscilloscope	Bandwidth: 20 cps - 20 kc Sensitivity: 0.2 mv/cm-5 v/cm Input Impedance: at least 15K ohms	Waveform measurements and observation	hp 130C
VHF Detector	Range: 10 to 480 mc Sensitivity: approximately 5 μvolts	Main frequency calibration	hp 417A
Detector Mount	Frequency Range: 10 mc-420 mc Frequency Response: ±0.5 db Sensitivity: Approx 0.35 mw/100 mv	General purpose detector	hp 423A
RF Power Meter and Bolometer Mount	Power Range: 0.01-10 mw Frequency Range: 40-420 mc Accuracy: ±5% of reading	VHF output power measurements	hp 431B Meter and hp 478A Mount
Pulse Generator	Output: +5 volts peak Frequency Range: 40-420 mc Rise Time: $\geq$4 μsec, 40-220 mc $\geq$1 μsec, 220-420 mc	External pulse modulation of generator	hp 212A
Test Oscillator	Frequency Range: 20 cps-20 kc Output: 0.5 vrms across 15K ohms	External AM of generator	hp 200AB
Head Phones	Impedance: 600 ohms	Main Dial Frequency Calibration	---

Table 4-2. Power Supply Troubleshooting

Measure Voltage At:	Normal Indication	Service Note
T1 (filament windings)	6.3 volts ac rms	This voltage should be between 6.2 and 6.3 volts rms when the line voltage is 115 volts. A noticeably higher or lower voltage indicates that the line voltage is significantly more or less than 115 volts
C45 (across terminals)	-165V dc (regulated)	This is a stable regulated voltage set to -165V by adjustment of R80. If this voltage is significantly high, low, or erratic, check voltage across V15; it should be a steady 90 volts. For excessively high output, check V14; for too low output check V16A and output of CR12, 13, 14, 15 (100 vdc should be applied to pin 2 of V16A; figure 4-12). Low voltage to regulator will cause unstable operation of the regulator.

Table 4-2. Power Supply Troubleshooting (cont'd)

Measure Voltage At:	Normal Indication	Service Note
V16B (pin 6)	+225V dc (regulated)	This is a stable regulated voltage set to +225V by adjustment of R71. If this voltage is significantly high, check V12; if too low, check V13 and output of CR8-CR11 (390 vdc should be applied to pins 2 and 5 of V13). Low voltage to the regulator will cause unstable operation of the regulator.
FL1 (red band)	6.8 vdc (regulated)	This voltage is applied only to the two r-f tubes within the r-f generator housing. If this voltage is significantly high, one of the r-f tube filaments may be open.

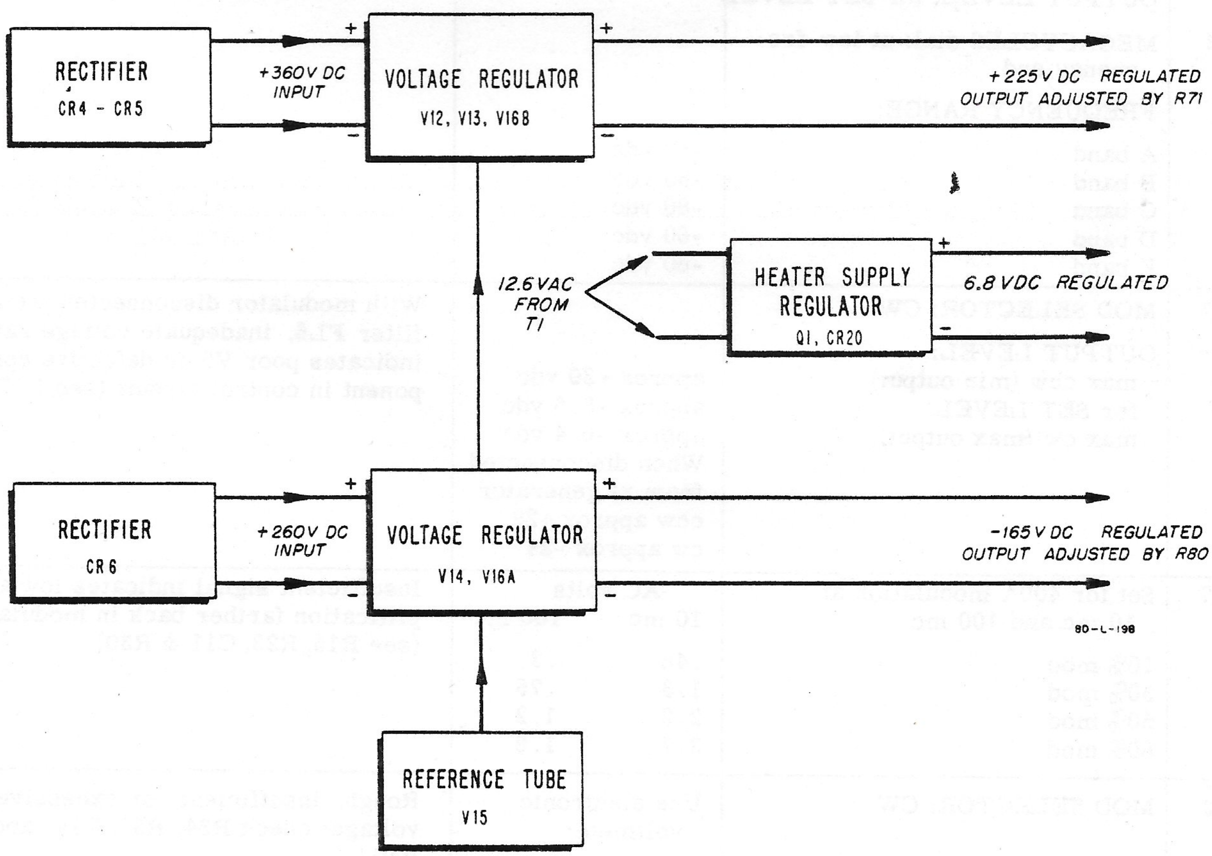


Figure 4-3. Block Diagram of Power Supply

Table 4-3. System Analysis Check Chart

Test Point	Controls		Normal	Possible Cause of Abnormal Indication
C42	MOD SEL	OUTPUT LEVEL		
	CW	for SET LEVEL max cw (max output) max ccw (min output)	260 vdc, 1.4 vac 90 ma dc 95 ma dc	Excessive ripple: C42 Low voltage: CR12 thru CR15 or excessive current drawn by subsequent circuits
	PULSE	for SET LEVEL	82 ma dc	
C45	CW	for SET LEVEL	-165 vdc 10 mv ac	See Table 4-2 (C45)
C40	CW	for SET LEVEL max cw	+340 vdc, 2.7 vac 155 ma dc	Excessive ripple: C40 Low voltage: CR8 thru CR11 or excessive current drawn by subsequent circuits
	400 ∿	for SET LEVEL	175 ma dc	
	PULSE	for SET LEVEL	147 ma dc	
Pin 6 V16B	CW	for SET LEVEL	+225 vdc 10 mv ac	See Table 4-2 (V16B)
FL1	Any position		6.8 vdc	See Table 4-2 (FL1)
C25 & R42	MOD SELECTOR: CW OUTPUT LEVEL: for SET LEVEL MEGACYCLES dial: at low-frequency end FREQUENCY RANGE:			Check -165V Supply, oscillator tube and associated components
	A band		-60 vdc	
	B band		-80 vdc	
	C band		-80 vdc	
	D band		-60 vdc	
	E band		-60 vdc	
CR7	MOD SELECTOR: CW OUTPUT LEVEL: max ccw (min output) for SET LEVEL max cw (max output)		 approx +30 vdc approx +3.6 vdc approx -6.4 vdc When disconnected from rf generator ccw approx +29 cw approx -24	With modulator disconnected from filter FL6, inadequate voltage range indicates poor V5 or defective component in control circuit (see C12).
CR7	Set for 400∿ modulation at 10 mc and 100 mc		AC volts 10 mc 100 mc	Insufficient signal indicates low amplification farther back in modulator (see R15, R23, C11 & R30).
	10% mod		.48 .3	
	30% mod		1.3 .75	
	50% mod		2.2 1.2	
	80% mod		3.7 1.8	
C12	MOD SELECTOR: CW		Use electronic voltmeter	Rough, insufficient, or excessive voltage: check R34, R37, R38, and R40
	OUTPUT LEVEL: max ccw (min output) for SET LEVEL max cw (max output)		 +23 vdc -2 vdc -30 vdc	

Table 4-3. System Analysis Check Chart (cont'd)

Test Point	Controls	Normal	Possible Cause of Abnormal Indication
J4	Turn off for this measurement	Nearly infinite resistance	50 ohms indicates shorted C37, or C69; 25 ohms indicates both C37 and C69 shorted.
R10	MOD SELECTOR 400∿ - 1000∿	 2 vac rms +6.4 vdc	 Adjust R7 to obtain correct voltage; if necessary, change I1
R15*	Set for 400∿ modulation at 10 mc 10% 30% 50% 80%	Use electronic voltmeter .017 vac .048 vac .083 vac .141 vac	Defective R2, MOD LEVEL control
R23	Set for 400∿ modulation at 10 mc 10% 30% 50% 80%	Use electronic voltmeter .068 vac .195 vac .32 vac .56 vac	Low output indicates weak V1. Gain should be approximately equal for these signal levels.
C11 & R30	Set for 400∿ modulation at 10 mc 10% 30% 50% 80%	 .58 vac 1.66 vac 2.8 vac 4.8 vac	Low output indicates weak V3. Gain should be approximately equal for these signal levels.
FL8	Set for 400∿ modulation at 10 mc 10% 30% 50% 80%	 .014 vac .044 vac .174 vac 1.2 vac	Low output indicates weak CR2 (and would be accompanied by inability to reack SET LEVEL on OUTPUT VOLTS meter). See Para 4-14.
FL8	MOD SELECTOR: CW Adjust OUTPUT LEVEL for OUTPUT VOLTS reading of: .1 volt half scale SET LEVEL full scale	 .05 vdc .16 vdc .23 vdc .32 vdc	These voltages vary depending upon forward resistance of CR2 and CR3; if variation is greater than ±10%, CR2 and/or CR3 may be bad.
Pin 2 V20	Set for 400∿ modulation at 10 mc 10% 30% 50% 80%	 .39 vac 1.0 vac 1.55 vac 2.50 vac	Low voltage indicates weak V18 or V19

* Note: The next five steps constitute a sequential check of the modulator amplifier and modulation meter amplifier circuits. The voltages shown for R15 are the approximate voltages required for modulation of the r-f output signal.

Table 4-4. Adjustments and Checks Required after Tube Replacement

Tube Positions	Check or Paragraph Reference
V1	Check operation with modulation
V2	Check operation with internal modulation
V3	Check operation with internal modulation
V4	Check operation with internal modulation
V5	Check range of output level control (should obtain 0 to full-scale deflection on OUTPUT VOLTS meter)
V6	See paragraph 4-9
V8	See paragraph 4-10
V12-17	See paragraph 4-11
V18	Check for indication of modulation percentage
V19	Check for indication of modulation percentage
V20	Check for indication of modulation percentage
V21	Check zero set of PERCENT MODULATION meter

4-8 REPLACEMENT OF ELECTRON TUBES

When replacing tubes in the Model 608C, it is recommended that a check be made on the operation of the instrument before and after each new tube trial; and if no improvement is noticed, the original tube should be returned to the socket. Figure 4-4 locates all electron tubes in the equipment. Table 4-4 lists the tubes of the signal generator with a suggested check and paragraph reference if adjustments are necessary.

This instrument may have type 6AS7G tubes, replacing type 6080 tubes.

These tubes are electrically interchangeable, and replacement tubes can be of either type. The type 6AS7G tubes have special clamp adapters around the base, and these adapters should be placed on replacement tubes of the 6AS7G type. They may be discarded, however, if type 6080 tubes are used for replacement.

4-9 RADIO FREQUENCY OSCILLATOR TUBE REPLACEMENT

Replacement of the radio frequency oscillator tube V6 may affect the calibration of the frequency dial and may change the heater supply voltage for the oscillator and power amplifier tubes. In addition, the plate current of the pencil triode tubes may differ widely in a given application. The heater voltage must be checked and, if necessary, reset to proper value; plate current must be held to between 18 and 27 milliamperes by tube selection. To replace oscillator tube V6, refer to Figure 4-5 and proceed as follows:

a. Remove frequency dial and top plate from r-f generator housing to gain access to tube compartment. The frequency dial is accurately indexed on its hub by two pins which assure exact positioning upon replacement of dial on hub.

b. Remove socket from base of V6 by straight pull.

c. Remove cathode clip from tube.

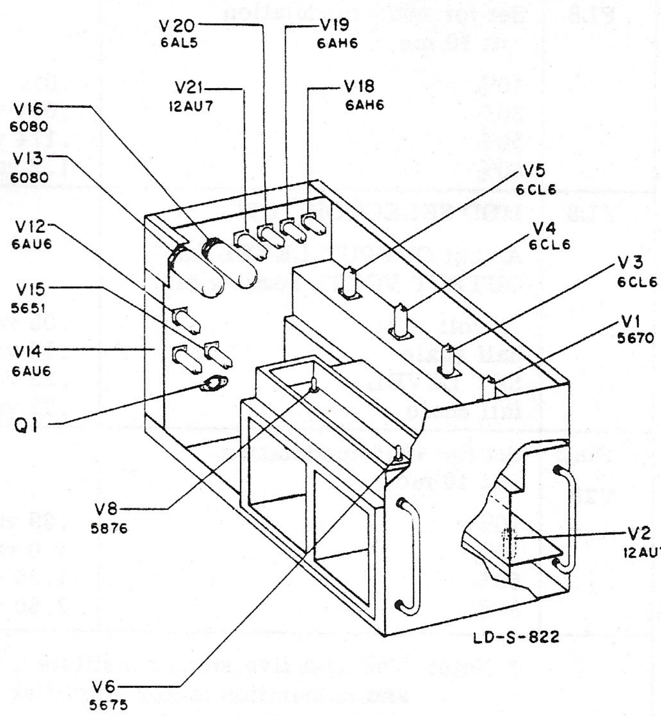


Figure 4-4. Tube Location

d. Remove the two 6-32 screws holding retainer plate; then remove plate and fiber spacer.

e. Lift tube gently from hole by straight pull.

f. Replace tube in reverse order of above steps.

g. Connect a dc voltmeter to the inside lead of FL1. The dc meter should indicate 6.3 vdc. If necessary, change the value of R127 to obtain 6.3 vdc.

h. With equipment turned off, break green lead to C15, a feed-thru type capacitor in the r-f generator tube compartment, and insert a 0-50 ma milliammeter.

i. Set the frequency range switch to the E band and turn equipment on. Milliammeter should read between 18 and 27 ma. If it does not, try another replacement tube.

j. Using an external standard calibrator of known accuracy, check the frequency calibration throughout the range of the signal generator, noting points that are significantly off frequency.

k. To correct the frequency calibration at the high frequency end of all bands simultaneously, adjust trimmer capacitor C18, which is accessible in the tube compartment in r-f generator housing. This adjustment has only minor effect at the low frequency ends of the ranges.

4-10 RADIO FREQUENCY AMPLIFIER TUBE REPLACEMENT

Replacement of the r-f amplifier tube can affect the heater voltage applied to r-f oscillator and power amplifier tubes in the generator housing and may also limit the maximum power output available from the signal generator. Both of these possibilities should be checked as described below. To remove r-f amplifier tube V8, refer to Figure 4-5 and proceed as follows:

a. Remove frequency dial and top plate from r-f generator housing to gain access to tube compartment.

b. Remove socket from base of V8 by straight pull.

c. Remove cathode clip from tube.

d. Using the special wrench located on instrument chassis convenient to generator housing, loosen threaded retainer ring which holds V8 in housing. Remove retainer ring and neoprene washer.

e. Withdraw old tube and replace with new type 5876 tube

f. Following replacement of V8, check and, if necessary, adjust the heater voltage as instructed in paragraph 4-9g for the r-f oscillator tube.

g. Check the power output throughout the full frequency range of the signal generator reading the self-contained power level meter with the AMP. TRIMMER control set for maximum output. A full-scale reading should be obtainable over the entire frequency range.

4-11 REPLACEMENT OF ELECTRON TUBES WITHIN THE REGULATED POWER SUPPLIES

The output voltage from either or both of the regulated power supplies may be affected slightly by a change in any one of the tubes within the supplies. The two power supplies are interdependent in that the setting of the +225-volt supply depends upon a reference point established by the -165-volt supply; therefore, a tube change in the -165-volt supply can also change the output from the +225-volt supply. All tubes and components in the power supplies are located on the chassis at the rear of the signal generator.

To check the output voltage from the power supplies following service or tube replacement, refer to Figure 4-9 and proceed as follows:

a. With the MOD. SELECTOR switch set to the 1000 position and the other controls in any position, turn equipment on.

b. Connect the positive lead of a voltmeter having a sensitivity of 5000 ohms per volt or better to ground.

c. Connect the negative lead to pin 7 of V15.

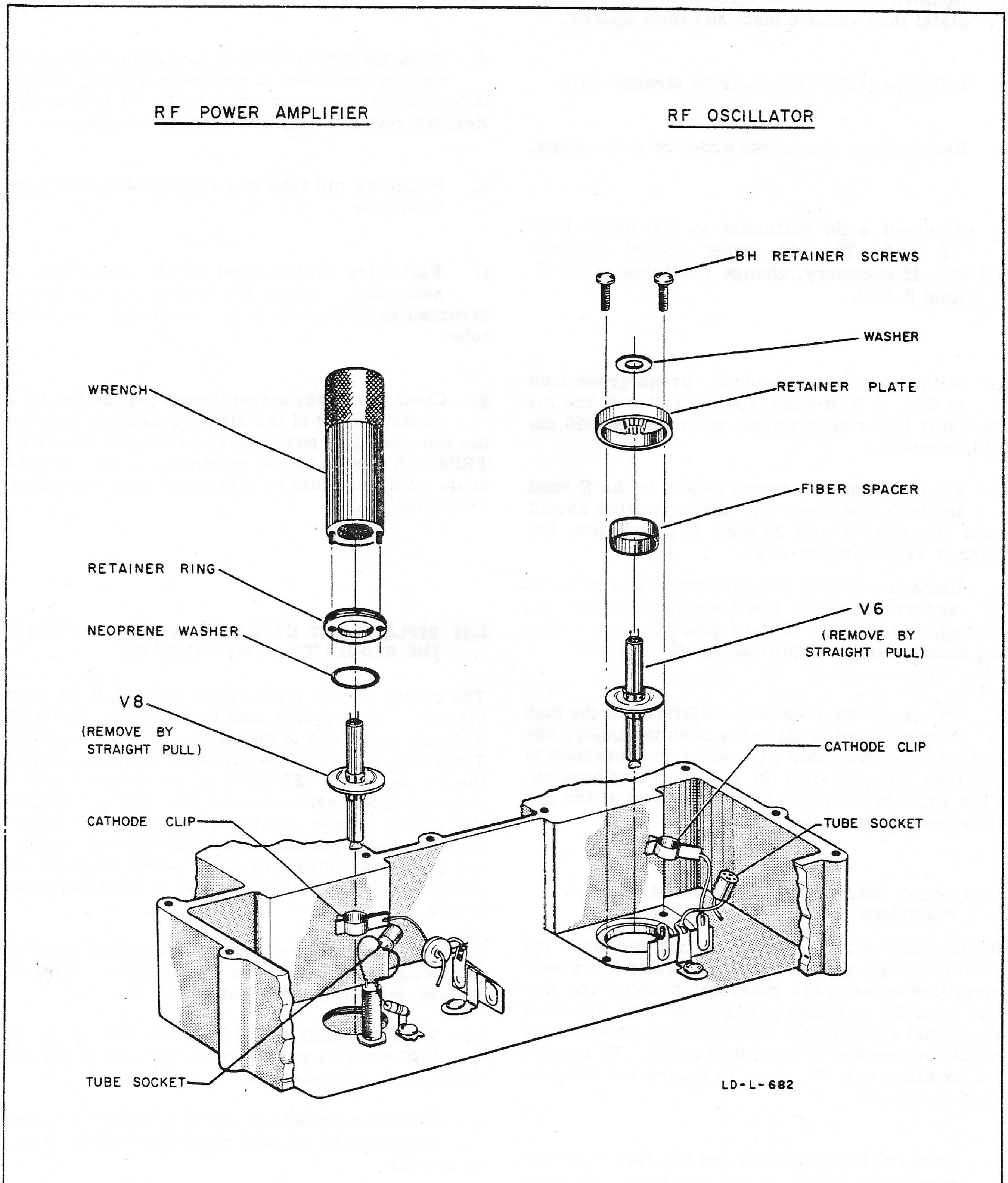


Figure 4-5. Diagram showing Tube Replacement for R-F Oscillator and Amplifier

d. Voltage should now read -165 volts. If necessary, adjust R80 to obtain -165 volts. This voltage should then remain stable with line voltage changes between 103 and 127 volts.

e. Reconnect voltmeter with the negative lead to ground and the positive lead to pin 6 of V13.

f. Voltage reading should be +225 volts. If necessary, adjust R71 to obtain +225 volts. This voltage must remain substantially constant with line voltage changes between 103 and 127 volts.

g. Connect a dc voltmeter to the inside lead of FL1. The dc meter should indicate 6.3 vdc. If necessary, change the value of R127 to obtain 6.3 vdc.

h. Voltage reading as read on the 412A volt meter scale should be approximately 6.8 volts. FL1 has approximately 0.4 volt IR drop; hence, the voltage on the tubes will read about 6.4 volts.

4-12 ATTENUATOR PROBE REPLACEMENT

If the electrical components of the output attenuator are damaged, such as described in the "WARNING" on page II-3 (paragraph 2-5), repair or replace if necessary. This condition may be confirmed by measuring the vswr of the attenuator at the RF OUTPUT jack. The vswr should measure less than 1.2. If investigation shows an attenuator to be defective, proceed as follows:

CAUTION: During removal and replacement of the probe, extreme care must be exercised. The probe consists of a cylindrical metal tube with a series of spring contact fingers around its periphery at one end, which can be accidentally bent or twisted. Also, it will be noted that one of the fingers is bent toward the center of the probe slightly. Do not attempt to straighten it since it has been made this way to assure clearance between the probe and the end of the guide slot in the attenuator housing. It is of greatest importance to make certain that the probe is not subjected to shock. If the probe is subjected to shock, the electrical components attached to the end of the probe can be broken or their position altered with a consequent change in the electrical characteristics of the probe.

a. Turn the attenuator control on the front panel until the probe reaches the end of its travel to the rear of the attenuator housing.

b. Refer to Figure 4-7b. Remove the nut and washer that hold the drive cable in the probe drive screw in the top of the attenuator probe. Lift the cable out of the screw slot.

c. Remove probe drive screw from probe body by removing inner nut and unscrewing.

d. Carefully remove the probe by sliding it out of the attenuator housing.

e. If the damage to the attenuator probe is limited to a burned out resistor and if a replacement resistor is available, the attenuator may be repaired by carefully unsoldering the old resistor, using a low temperature soldering iron, and replacing the resistor. Soldering must be done quickly and neatly with low temperature solder. Care must be taken to duplicate the original workmanship as closely as possible by positioning the new part exactly as the old one was and by applying as little heat in the soldering process as is possible.

f. If repair is not possible, the probe and cable must be replaced. It will then be necessary to remove the RF OUTPUT jack from the front panel and release the cable from the clamp holding the cable to the top of the side gusset. The entire probe assembly may then be removed from the instrument. Replacement probes are complete with cable and panel jack and require no adjustment of the impedance-matching network upon installation.

g. Insert the new or repaired probe in the attenuator housing. Care must be taken in starting the probe into the housing since the diameter at the probe contact fingers is slightly greater than the inner diameter of the housing. The contact fingers should be depressed slightly while starting the probe into its housing.

CAUTION: Under no circumstances should the probe be forced.

h. Replace the split drive screw in the probe, making certain that the screw slot is parallel to the axis of the housing.

i. Set the attenuator drive cable in the screw slot and replace both washers and nut. Do not tighten the nut. The cable must move freely through the slot until the probe penetration has been set.

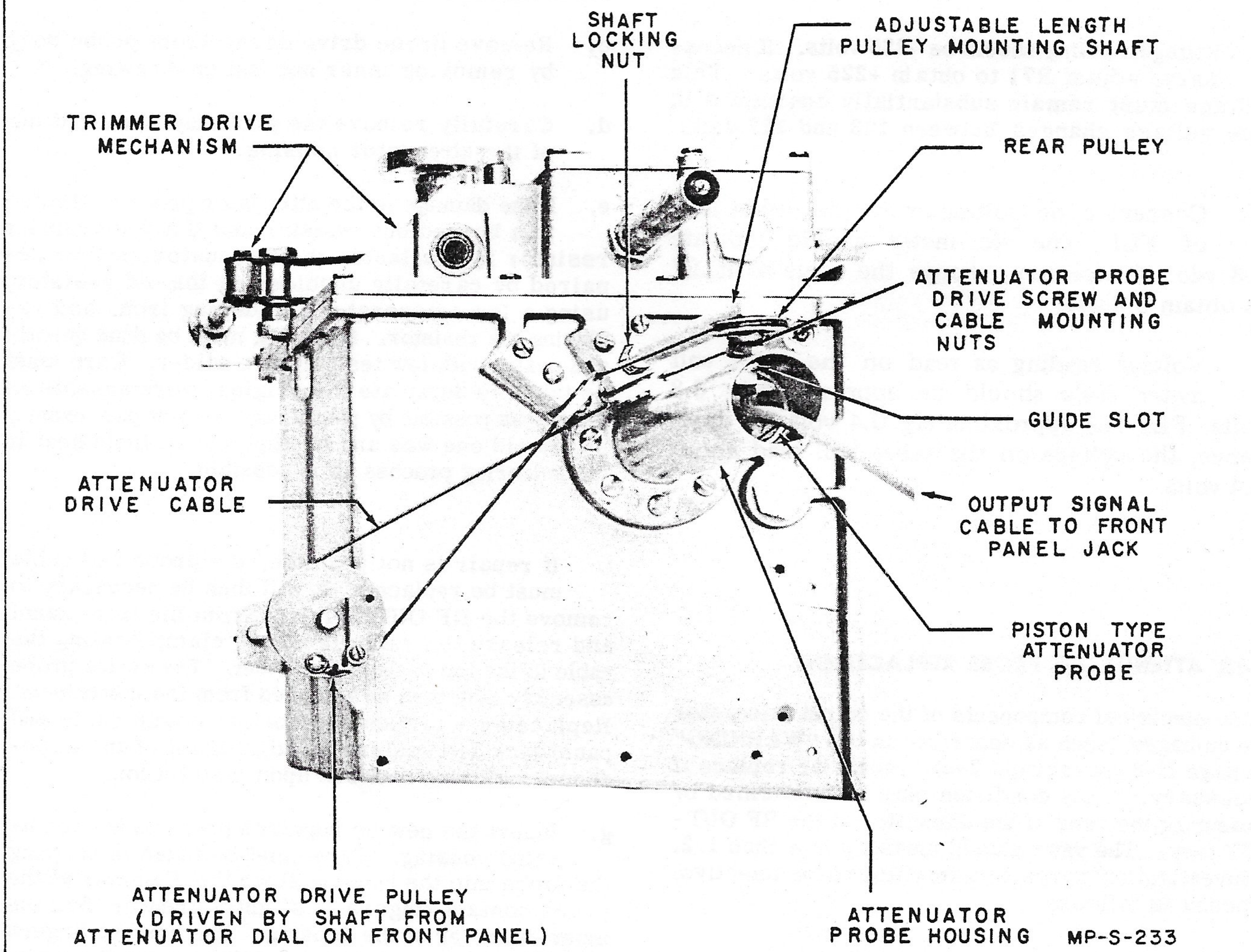


Figure 4-6. R-F Generator Assembly Rear View, Showing Output Attenuator Drive System

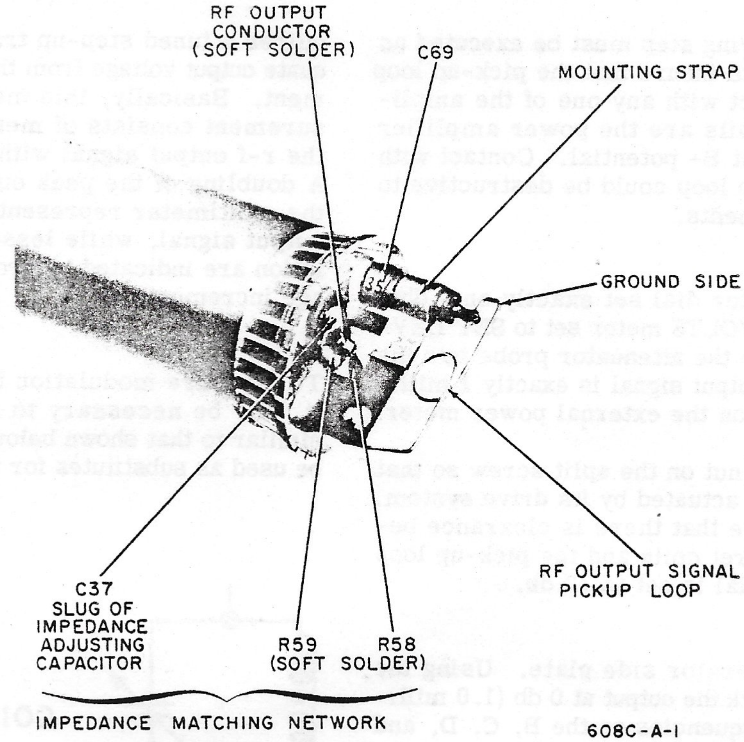


Figure 4-7a. R-F Output Attenuator Probe, showing Front View of Pickup Loop

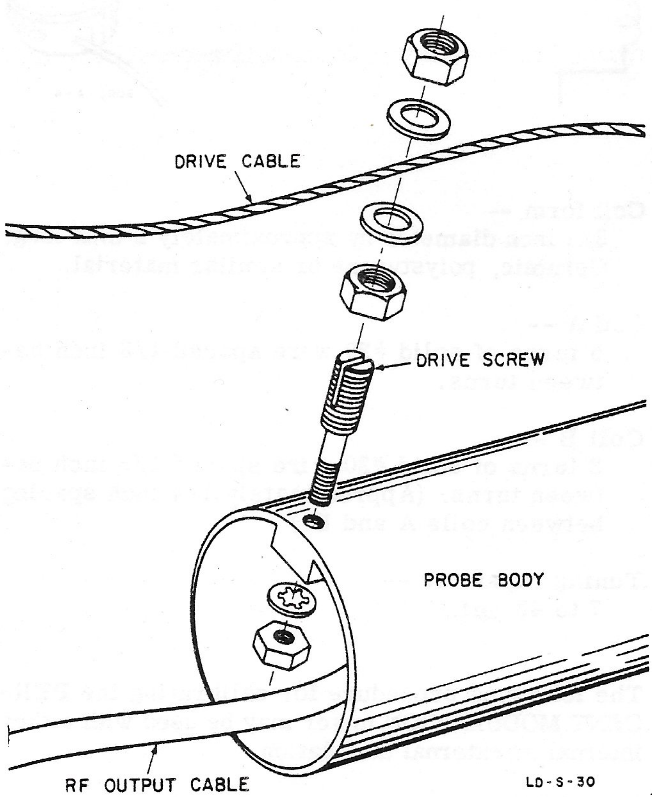


Figure 4-7b. Rear View Showing Attaching Parts

j. Secure the r-f cable to the clamp on the side gusset. (Cable routing is shown in Figure 4-9 and 4-10.)

k. Connect the instrument to a source of 115-volt a-c power. Turn on the power switch.

l. Unless otherwise specified, the operating controls should be set as follows:

MOD. SELECTOR	-	CW
FREQUENCY CONTROL	-	20 megacycles
FREQUENCY RANGE	-	A band
AMP. TRIMMER	-	Adjust for max. output
OUTPUT LEVEL	-	Adjust for SET LEVEL
MOD. LEVEL	-	Counterclockwise
Attenuator	-	0 dbm

m. Connect a power meter, such as the ⓗⓟ Model 430B, through a bolometer mount (ⓗⓟ Model 476A or equivalent) to the RF OUTPUT jack.

n. Remove r-f generator side plate so that clearance between the attenuator probe and r-f amplifier tank may be observed.

CAUTION: The following step must be executed as carefully as possible to insure that the pick-up loop does not make contact with any one of the amplifier coils. These coils are the power amplifier tuning coils and are at B+ potential. Contact with the attenuator pick-up loop could be destructive to the attenuator components.

o. With the attenuator dial set exactly on 0 dbm and the OUTPUT VOLTS meter set to SET LEVEL, manually advance the attenuator probe into the housing until the r-f output signal is exactly 1 milliwatt (0 dbm) as read on the external power meter.

p. Tighten down the nut on the split screw so that the probe may be actuated by its drive system. Carefully check to see that there is clearance between the various turret coils and the pick-up loop when the attenuator dial is set to +7 db.

q. Replace r-f generator side plate. Using the power meter, check the output at 0 db (1.0 milliwatt) at the higher frequencies on the B, C, D, and E bands. If necessary, the self-contained output meter calibration can be adjusted by means of R62 (see Figure 4-10). See paragraph 4-15 for complete OUTPUT VOLTS meter recalibration instructions.

4-13 REPLACEMENT OF LAMP I1

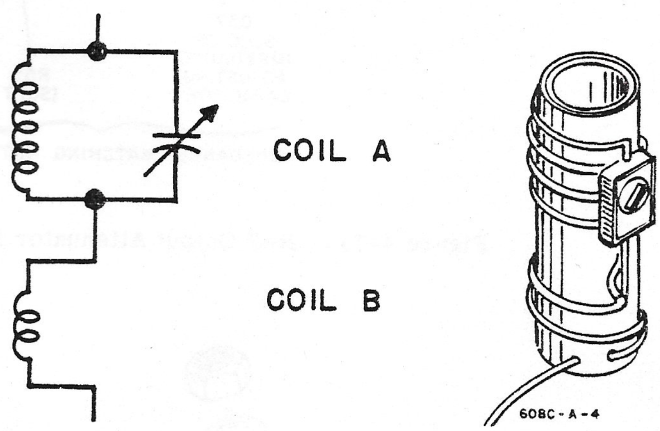
Lamp I1 acts as a thermal resistance having a high positive temperature coefficient and is used to maintain constant output voltage from the 400- and 1000-cycle oscillator. The S6 type lamps used for this purpose ordinarily vary widely from one lamp to another and produce widely varying output voltage from this oscillator. Potentiometer R7 is provided for adjustment of the oscillator output voltage for various S6 lamps.

After the lamp I1 has been replaced, the oscillator voltage, as measured at pin 3 of V2, should be adjusted to 2 volt rms; if it cannot be adjusted to this value, another lamp must be tried.

4-14 CALIBRATION OF THE PERCENT MODULATION METER

Recalibration of the PERCENT MODULATION meter may be necessary following a repair of the modulation measuring circuits or after replacement of the meter itself. The method of calibration outlined below requires the use of a peak-reading electronic voltmeter capable of measuring a-c voltages to 500 megacycles, such as the ℎ𝑝 Model 410B, and requires a tuned step-up transformer to obtain adequate output voltage from the generator for measurement. Basically, this method of modulation measurement consists of measuring the peak value of the r-f output signal with and without modulation. A doubling of the peak output voltage indicated on the multimeter represents 100% modulation of the output signal, while lesser percentages of modulation are indicated by proportionally smaller voltage increments.

To measure modulation by the voltmeter method, it will be necessary to fabricate a tuned circuit similar to that shown below. Materials at hand may be used as substitutes for those listed.



Coil form --
3/4 inch diameter by approximately 2 inch long. Ceramic, polystyrene or similar material.

Coil A --
5 turns of solid #20 wire spaced 1/8 inch between turns.

Coil B --
2 turns of solid #20 wire spaced 1/8 inch between turns. (Approximately 1/4 inch spacing between coils A and B.)

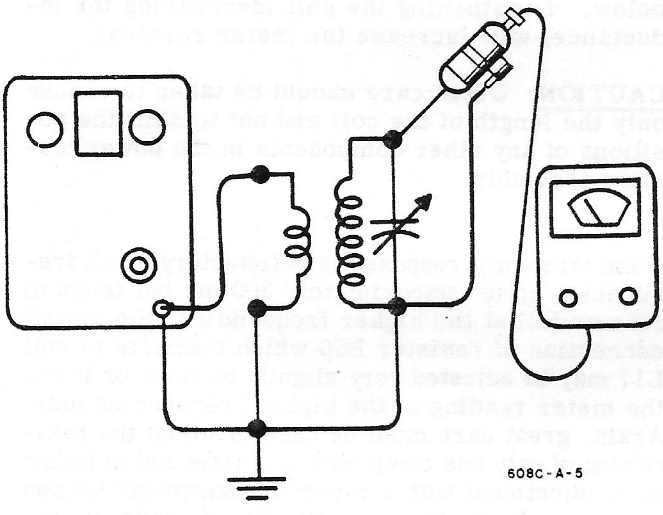
Tuning capacitor --
7 to 45 $\mu\mu$f.

The following procedure for calibrating the PERCENT MODULATION meter may be used with either internal or external modulation.

a. With the controls set as below, turn the power switch on and allow the instrument to warm up.

FREQUENCY RANGE	-	C band
MEGACYCLES dial	-	75 to 85 mc
MOD. SELECTOR	-	1000
AMP. TRIMMER	-	Adjust for max. output
OUTPUT VOLTS meter	-	Adjust to SET LEVEL
PERCENT MODULATION	-	Adjust for 0%
Attenuator	-	0 dbm

b. Connect the signal generator to the test apparatus as shown in the diagram below.



Model 608C VHF Signal Generator   Model 410B VHF Vacuum Tube Voltmeter

c. Set the 410B voltage range switch to the 10-volt a-c range.

d. Adjust the capacitor on the r-f transformer to obtain maximum output as read on the vacuum tube voltmeter.

e. Reading on the 0- to 3- volt scale on the 410B, adjust the output attenuator on the 608C for a reading on 1 volt on the 410B.

NOTE: The actual voltage from the tuned circuit will be within the 10-volt range; however, the linear portion of the 3-volt scale can be used as a modulation indicator since the 1-volt calibration mark now represents 0% modulation and the 2-volt calibration will represent 100% modulation, with the intermediate calibrations corresponding to the calibrations on the PERCENT MODULATION meter in the signal generator. Accuracy of modulation indication as read from the 410B Voltmeter will be approximately ±5% or better.

f. Adjust the MOD. LEVEL control for a reading corresponding to 1.8 on the 410B voltmeter.

g. Application of high percentages of modulation may result in a slight rise (1/2 db) in the OUTPUT VOLTS meter indication. If necessary, re-adjust the OUTPUT LEVEL control to obtain a reading at SET LEVEL on the OUTPUT VOLTS meter.

h. Adjust R104 (see Figure 4-8) to provide a reading of 80% on the PERCENT MODULATION meter.

i. Check the meter calibration for other modulation percentages, e.g., 1.1 on the voltmeter corresponds to 10% modulation, 1.2 to 20%, etc. The setting of R104 may be refined to obtain best overall calibration accuracy of the PERCENT MODULATION meter.

NOTE: For this procedure the OUTPUT LEVEL control must be set at all times to provide a reading at SET LEVEL on the OUTPUT VOLTS meter.

4-15 OUTPUT VOLTS METER CALIBRATION AND R-F POWER MONITOR SERVICE

Recalibration of the OUTPUT VOLTS meter may be necessary following replacement of the attenuator probe, components in the power monitoring circuits, or replacement of the meter itself. If it becomes necessary to replace CR2 or R60 in the power monitor assembly, the frequency response of the meter circuit will also be affected and must be readjusted.

CAUTION: Do not disturb the positioning of the components in the r-f power monitor assembly (see Figure 4-11) until instructed to do so in procedure. The position and lead lengths of resistor R60 and L17 and the characteristics of crystal CR2 all affect the frequency response of the meter circuit, mostly on the E band and to a lesser degree on the D band. To restore "flat" frequency response requires care and skill in repositioning.

The method of calibration outlined below requires the use of a 50-ohm bolometer mount and power meter, such as the Model 476A Universal Bolometer Mount and Model 430C Power Meter, to measure the r-f signal power from the generator. To reset the frequency response of the higher bands, such as following replacement of CR2 or R60, the OUTPUT VOLTS meter must first be checked for accuracy as described in steps a. through i. below, then adjusted as described in step j. Proceed as follows:

a. Connect the 608C to a source of 115-volt a-c power. Turn on the power switch and allow to warm up with the operating controls in the following positions:

MOD. SELECTOR	-	CW
FREQUENCY CONTROL	-	75 to 80 megacycles
FREQUENCY RANGE	-	C band
AMP. TRIMMER	-	Adjust for max. output
OUTPUT LEVEL	-	Adjust for SET LEVEL
MOD. LEVEL	-	Extreme ccw
Attenuator	-	0 dbm

b. Connect the power meter and bolometer mount to the RF OUTPUT jack on the signal generator.

c. With the attenuator set for exactly 0 dbm, adjust the OUTPUT LEVEL control to obtain exactly 1 milliwatt (0 dbm) on the external power meter.

d. If necessary, adjust R62 to obtain an exact reading at SET LEVEL on the self-contained OUTPUT VOLTS meter.

e. Using the db scale of the OUTPUT VOLTS meter, check the +4 and +13 calibration points with the external power meter (points -3 and +6 db from SET LEVEL where calibration took place).

f. Adjust the OUTPUT LEVEL control for -3 dbm as read on the external power meter. If necessary, adjust R62 to obtain a reading of +4 db on the self-contained OUTPUT VOLTS meter.

g. Set OUTPUT LEVEL control for +6 dbm as read on the external power meter. If necessary, adjust R61 to obtain a reading of +13 db on the self-contained OUTPUT VOLTS meter.

h. Because the two adjustments R61 and R62 are inter-active, steps f. and g. must be repeated to obtain best overall accuracy of calibration.

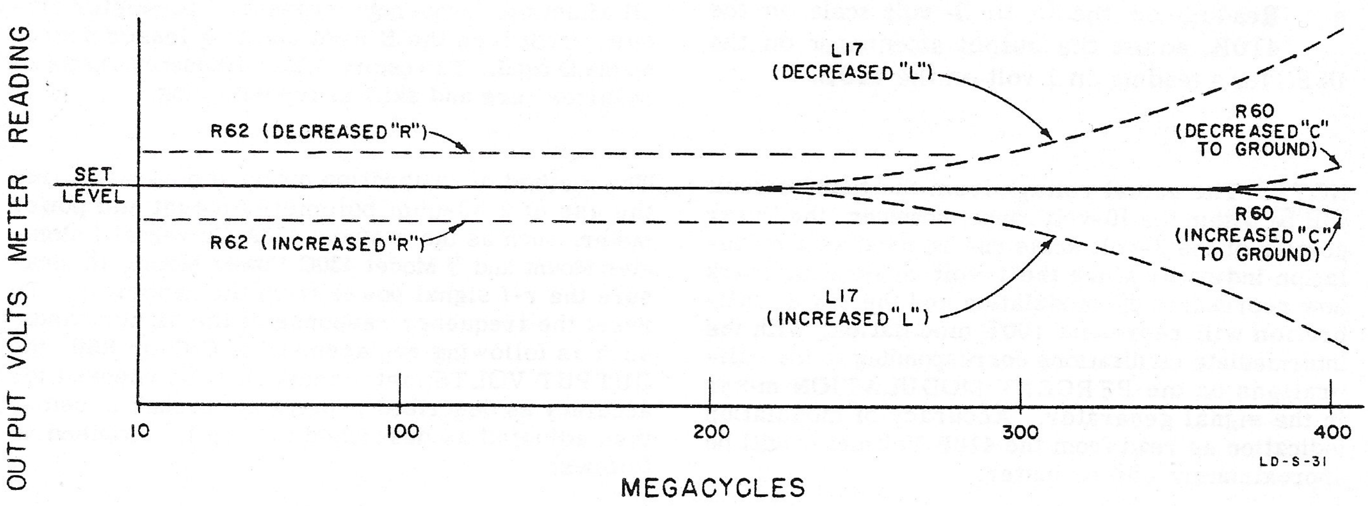
i. Recheck accuracy of calibration at SET LEVEL (0 dbm on the external power meter) and, if necessary, adjust R62 to obtain an exact reading at this point.

j. Recheck calibration at SET LEVEL at frequencies of 100, 250, and 400 megacycles. If the calibration is high or low at the higher frequencies, the OUTPUT VOLTS meter reading may be corrected by adjusting the inductance of L17. Shortening the coil (increasing the inductance) will decrease the meter reading as shown in the diagram below. Lengthening the coil (decreasing the inductance) will increase the meter reading.

CAUTION: Great care should be taken to change only the length of the coil and not to shift the positions of any other components in the power monitor assembly.

If the frequency response is satisfactory at all frequencies up to approximately 300 mc but tends to rise or fall at the higher frequencies, the pigtail connection of resistor R60 which connects to coil L17 may be adjusted very slightly to raise or lower the meter reading at the higher frequencies only. Again, great care must be used to adjust the positioning of only one component at a time and to follow each adjustment with a power measurement to see the exact effect of the adjustment. In general, increasing the capacity between this pigtail and ground may be expected to decrease the meter reading at only the higher frequencies.

The graph below shows the increase or decrease in the reading of the OUTPUT VOLTS meter that is obtained at different frequencies when making each one of the three possible adjustments. Only very small adjustments should be made (very small change in physical position), using the graph for a guide as to the approximate results that may be expected.



4-16 TROUBLE SHOOTING CHART

SYMPTOM	POSSIBLE TROUBLE	SUGGESTED CHECK AND REMEDY
1. A. Low r-f output (cannot obtain full-scale reading on output level meter).	Low heater voltage from V17. Weak oscillator V6. Weak amplifier V8.	Check heater voltage. If necessary, set to 7 volts as described in paragraph 4-10. Check V6 and V7 by measurement of r-f signal at cathode of V8 in tube compartment. Should be 4 to 11 volts. Replace tubes to improve.
	Low power supply voltage.	Check the +225 volt and the -165 volt supplies.
B. No r-f output (output level meter indicates normal output).	Open attenuator impedance-matching network.	Check SWR at output jack or visually inspect attenuator
C. Low cw output at low frequency end of the E band.	Weak V6. Weak V8.	Check by replacing V6. Check by replacing V8.
D. Intermittent operation on any one band.	Poor connections at contacts on oscillator or amplifier coil turrets.	Clean contacts. If necessary, bend turret contact slightly for greater pressure.
2. Output signal cannot be reduced by OUTPUT LEVEL control (output meter remains upscale).	Weak V5.	Check by replacing V5.
3. Frequency calibration inaccurate at high frequency ends of all bands.	Tube characteristic differences following replacement of V6.	Adjust C18 for correct calibration at top of all bands. See paragraph 4-7.
4. A. Output level drifts.	Weak V6.	Check V6 by replacing.
B. Output level drifts (with changes in line voltage).	Power supply does not regulate properly.	Check stability of regulated +225- and -165-volt supplies. Check V12 and V13 for defective +225-volt supply and V14 and V16 for defective -165-volt supply.
C. High residual hum on output signal may be read on PERCENT MODULATION meter when no modulation is applied.	Same as above.	Same as above.

TROUBLE SHOOTING CHART (CONT'D.)

SYMPTOM	POSSIBLE TROUBLE	SUGGESTED CHECK AND REMEDY
5. Little or no indication from output meter, output signal normal.	Check meter M1. Check crystal diode CR2 and refer to "CAUTION" on pages IV-11 and IV-12 (paragraph 4-13).	If necessary, replace M1 or CR2 and recheck calibration of OUTPUT VOLTS meter. If necessary, adjust R62 (see paragraph 4-13) for best accuracy.
6. Change in mod. percent causes change in output level meter. (About 10% is normal at high modulation percentages.)	Overmodulation can be due to actual r-f signal being less than indicated amount or due to modulation being greater than indicated amount.	Check amplitude of r-f output signal with external output meter. Check modulation of r-f carrier by viewing on oscilloscope. Check gain of modulation indicator amplifier.
7. Distortion of the modulation envelope, particularly at high modulation levels.	Weak r-f power amplifier V8. Weak r-f oscillator V6. Distorted modulating wave from oscillator V2 or amplifier V3.	Check by replacement of V8. Check r-f drive to power amplifier. Should be up to 4 volts on E band. Check distortion of the modulating sinewave from modulator V5.
8. No internal modulation signal.	Loose 3-watt lamp I1 in modulation oscillator V2.	Tighten lamp in socket.
9. RF output signal does not go zero when generator is switched to PULSE operation and no pulses are applied.	Weak cathode follower V4 in modulator.	Replace V4.

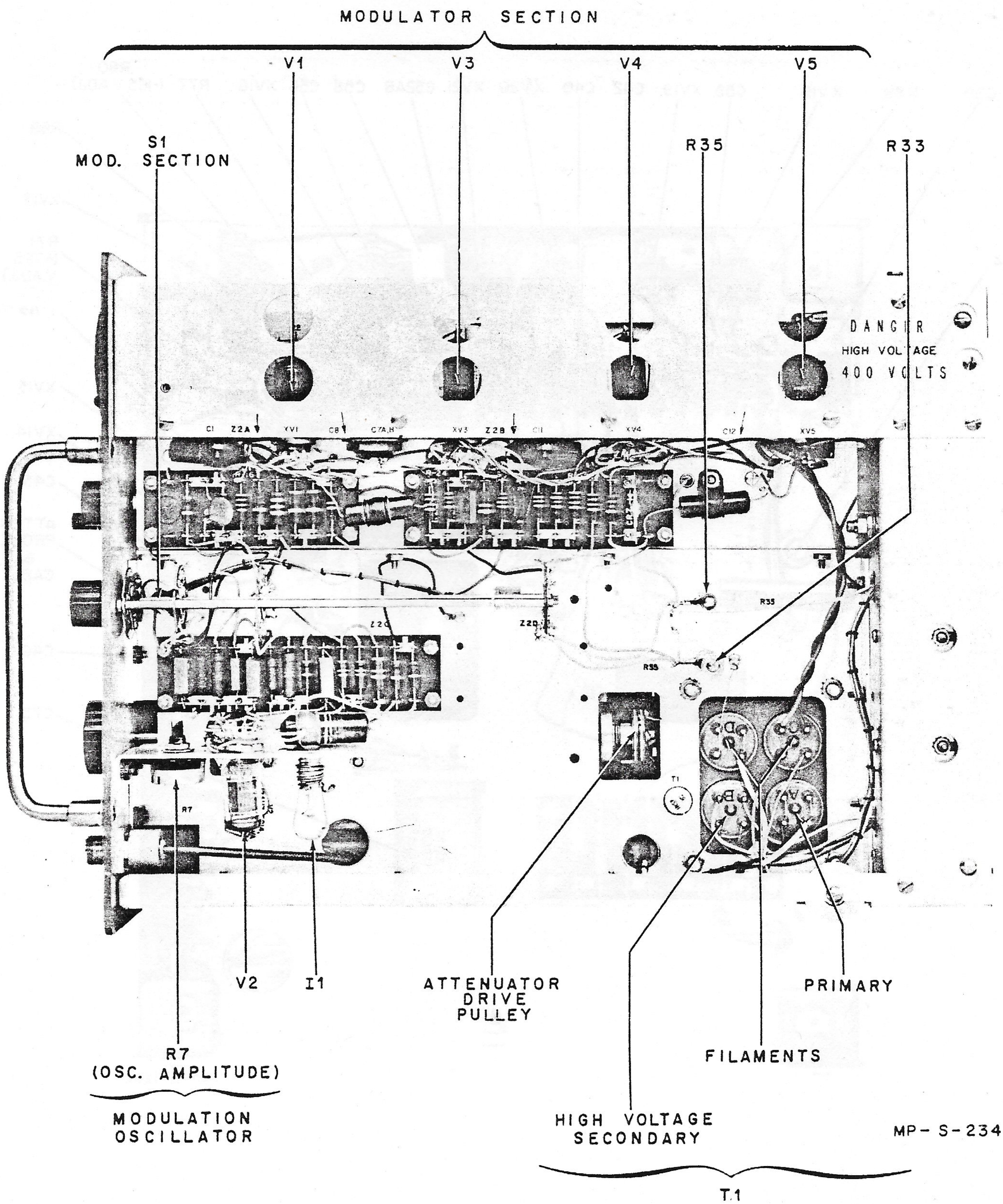


Figure 4-8. Signal Generator Model 608C Right Side View, Cabinet Removed

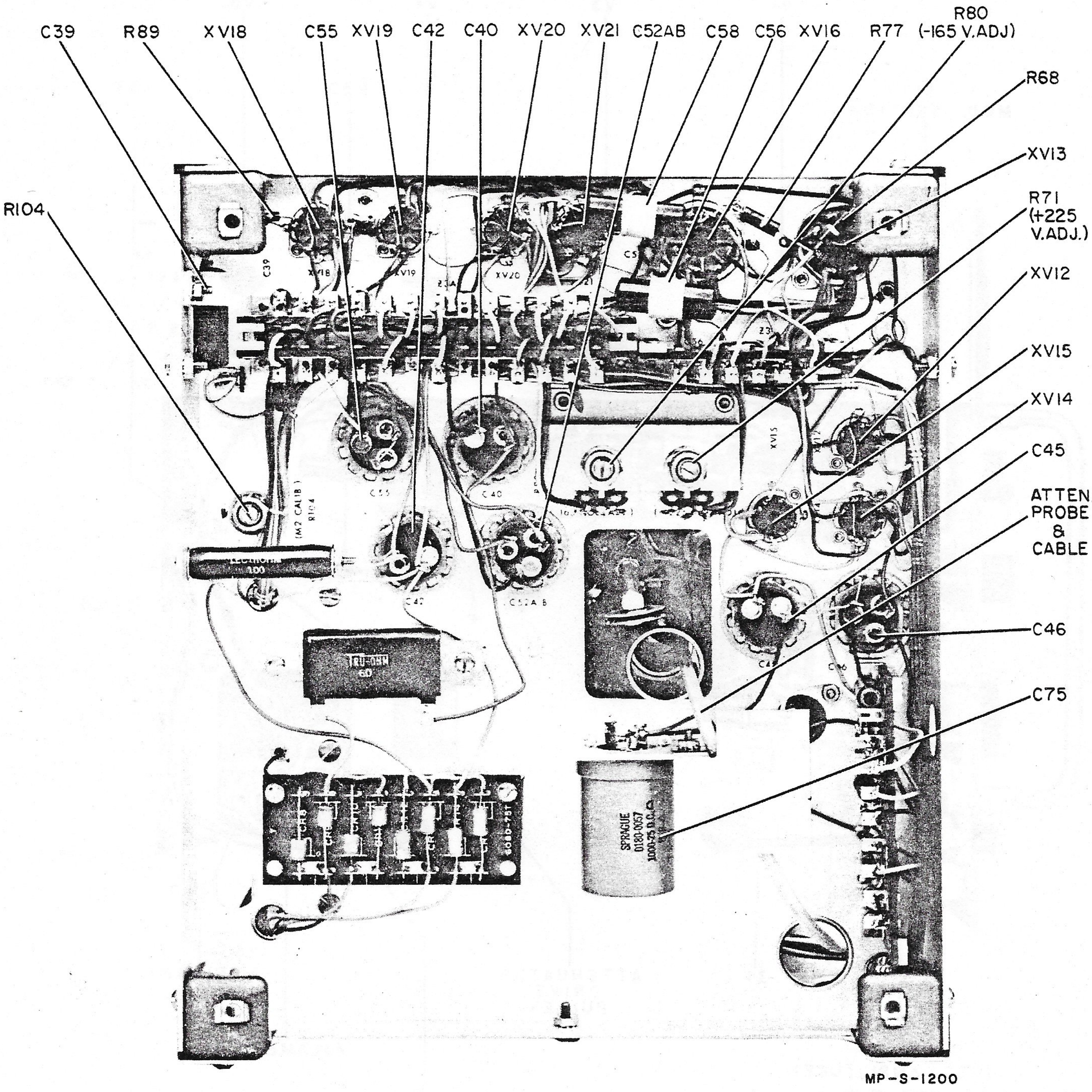


Figure 4-9. Signal Generator Model 608C Rear View, Cabinet Removed

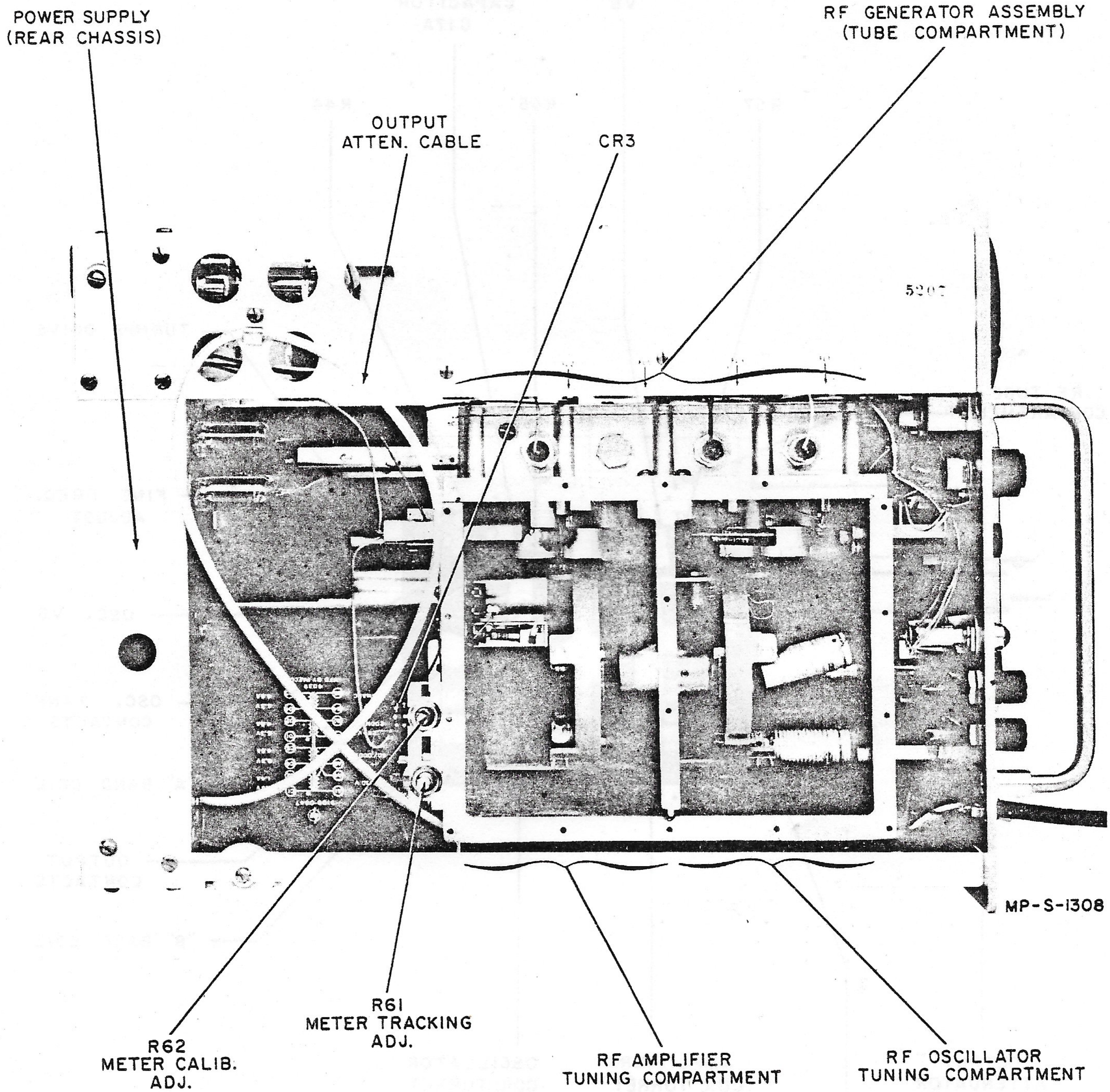


Figure 4-10. Signal Generator Model 608C Left Side View, Cabinet Removed

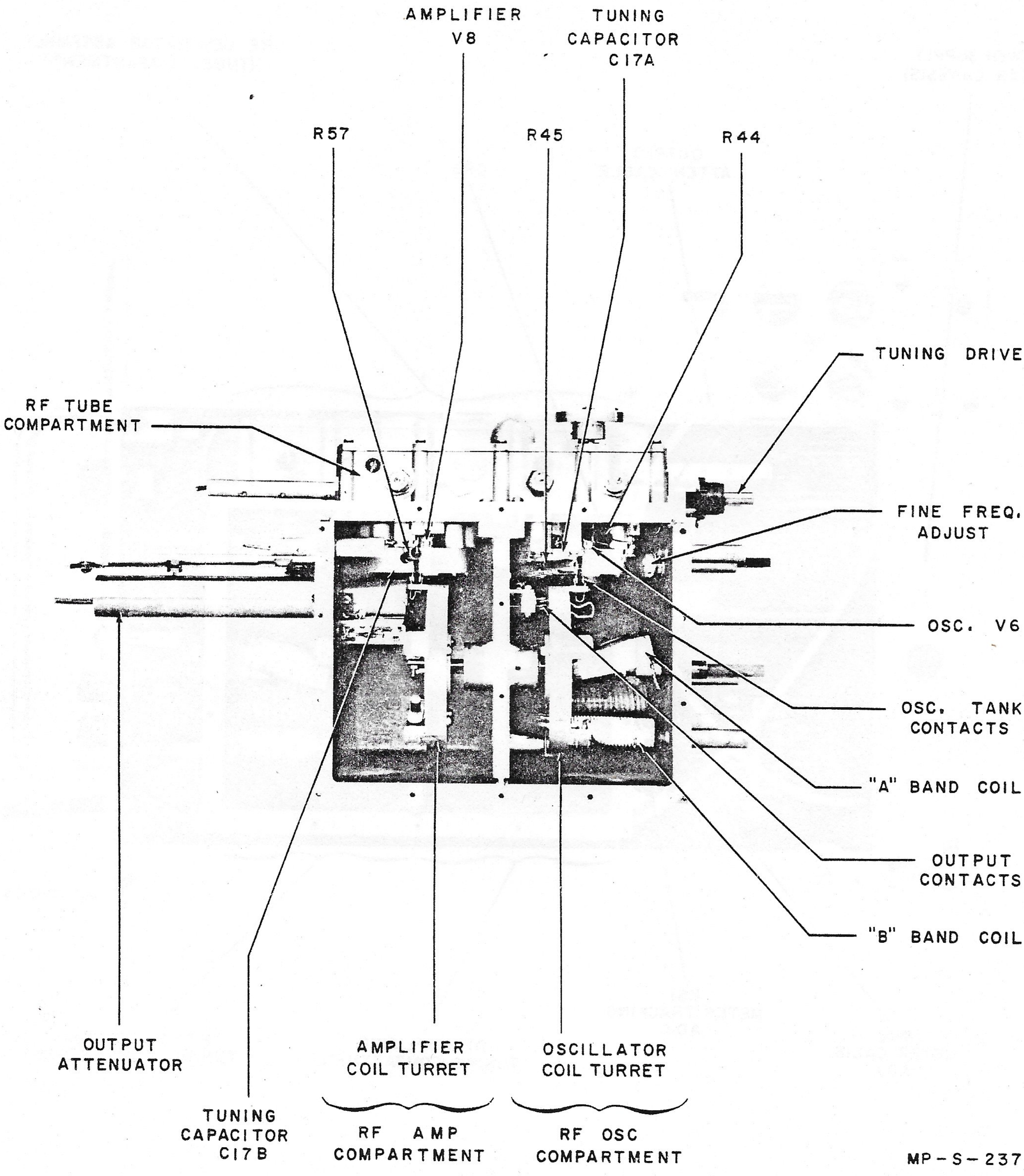


Figure 4-11. R-F Generator Assembly,
Side Plate Removed to Show Tuning Compartments

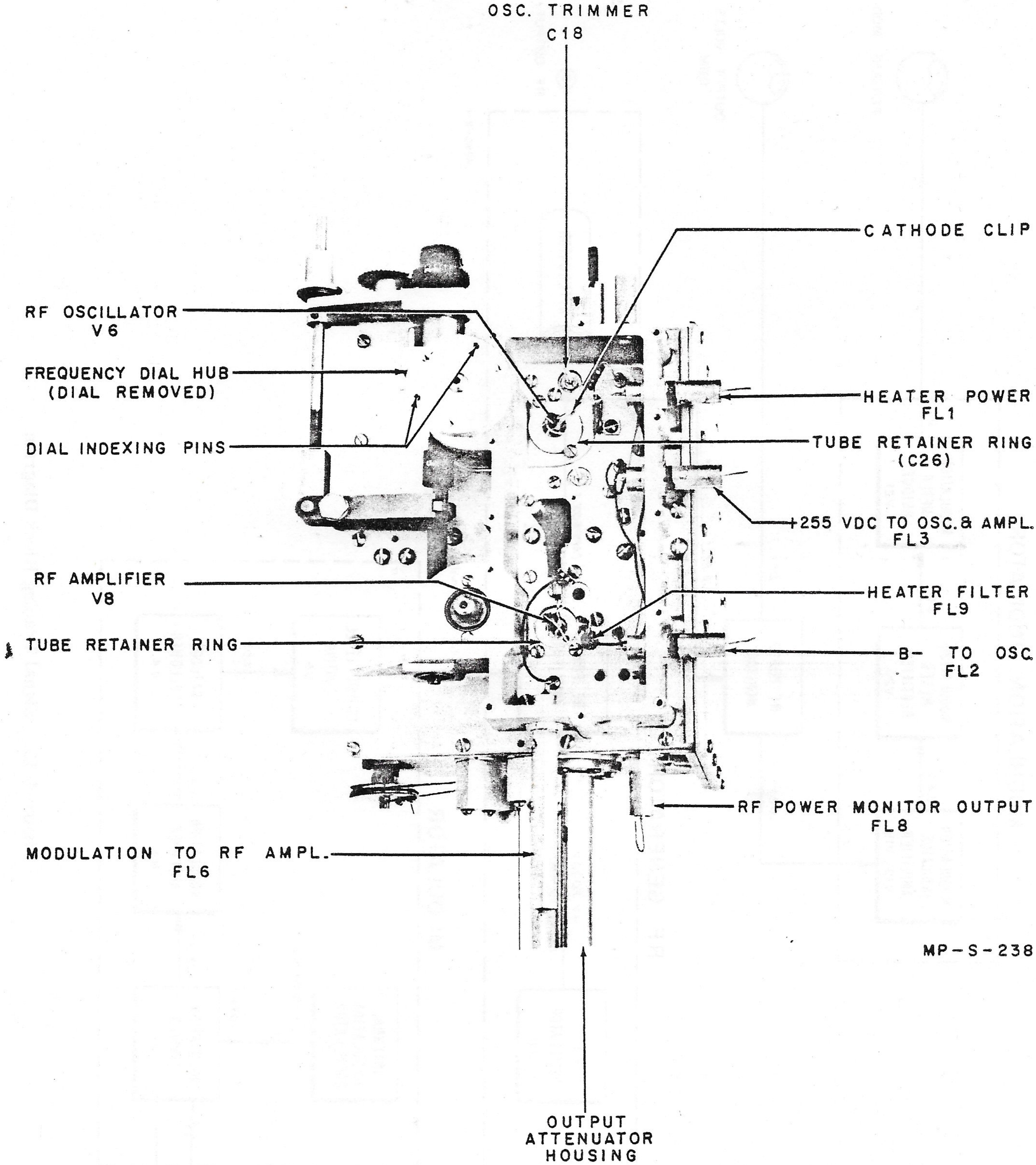


Figure 4-12. Tube Compartment of R-F Generator Assembly, Frequency Dial and Cover Plate Removed

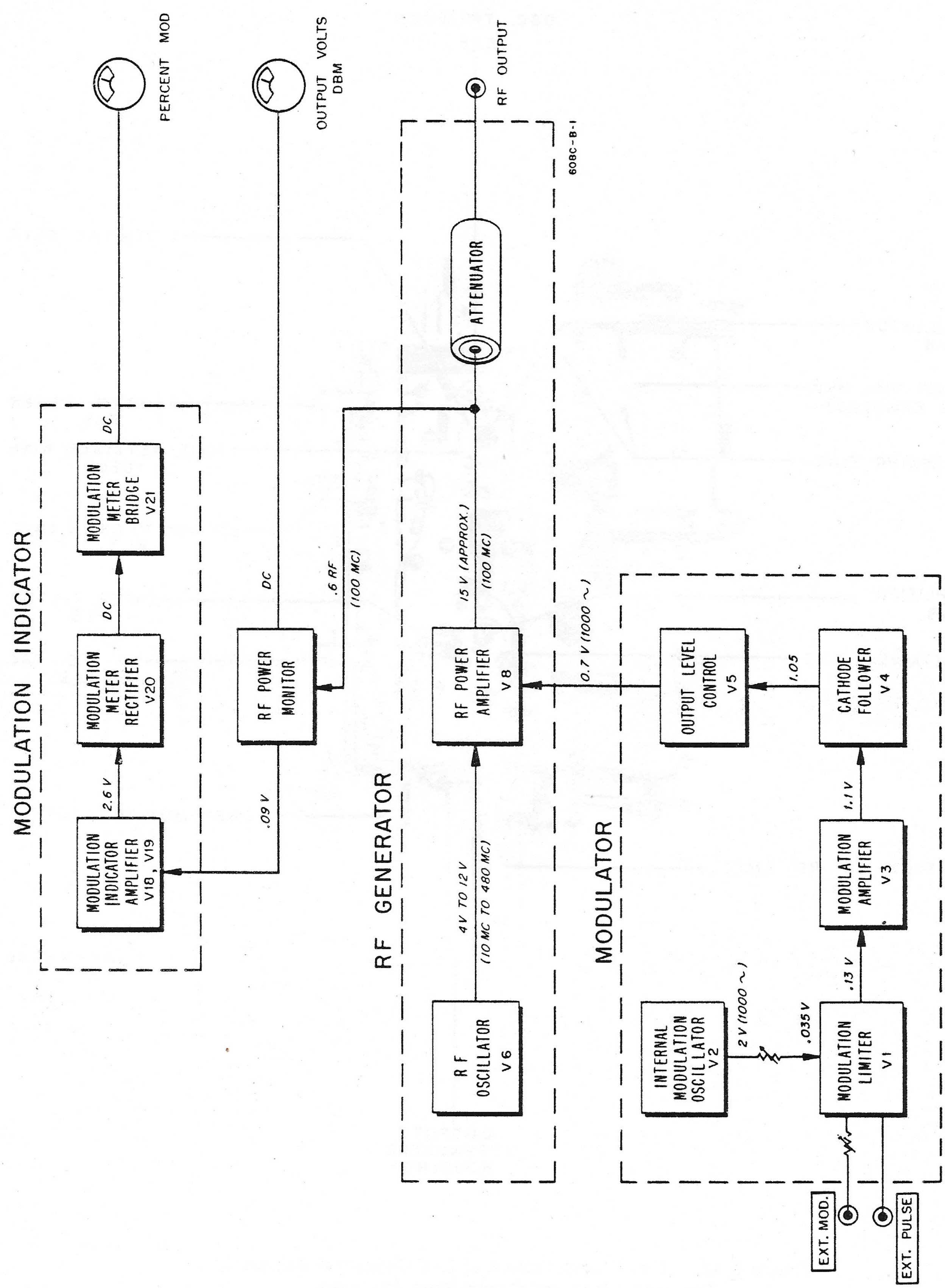


Figure 4-13. Signal Tracing Block Diagram

NOTES PERTAINING TO TUBE SOCKET VOLTAGE-RESISTANCE DIAGRAMS

1. CONDITIONS OF MEASUREMENT

Unless otherwise noted, measurements made with respect to chassis ground using voltmeter having 20,000-ohm-per-volt sensitivity and with front panel controls at the following settings:

FREQUENCY	100 MC
MOD. SELECTOR	1000 ∿
MOD. LEVEL	30 %
OUTPUT LEVEL	Set Level

R71 and R80 in the power supply section were set to provide the normal supply voltages of +225V and -165V, respectively.

2. 20,000-ohm-per-volt meter cannot be used for this measurement since it will load the circuit and provide an erroneous reading. A vacuum-tube voltmeter should be used here.
(Note referenced on Figures 4-14, 4-15.)

3. Reading taken at minimum and maximum setting of OUTPUT LEVEL control.
(Note referenced on Figures 4-14, 4-16.)

4. Voltages measured with respect to -165V bus.
(Note referenced on Figure 4-15.)

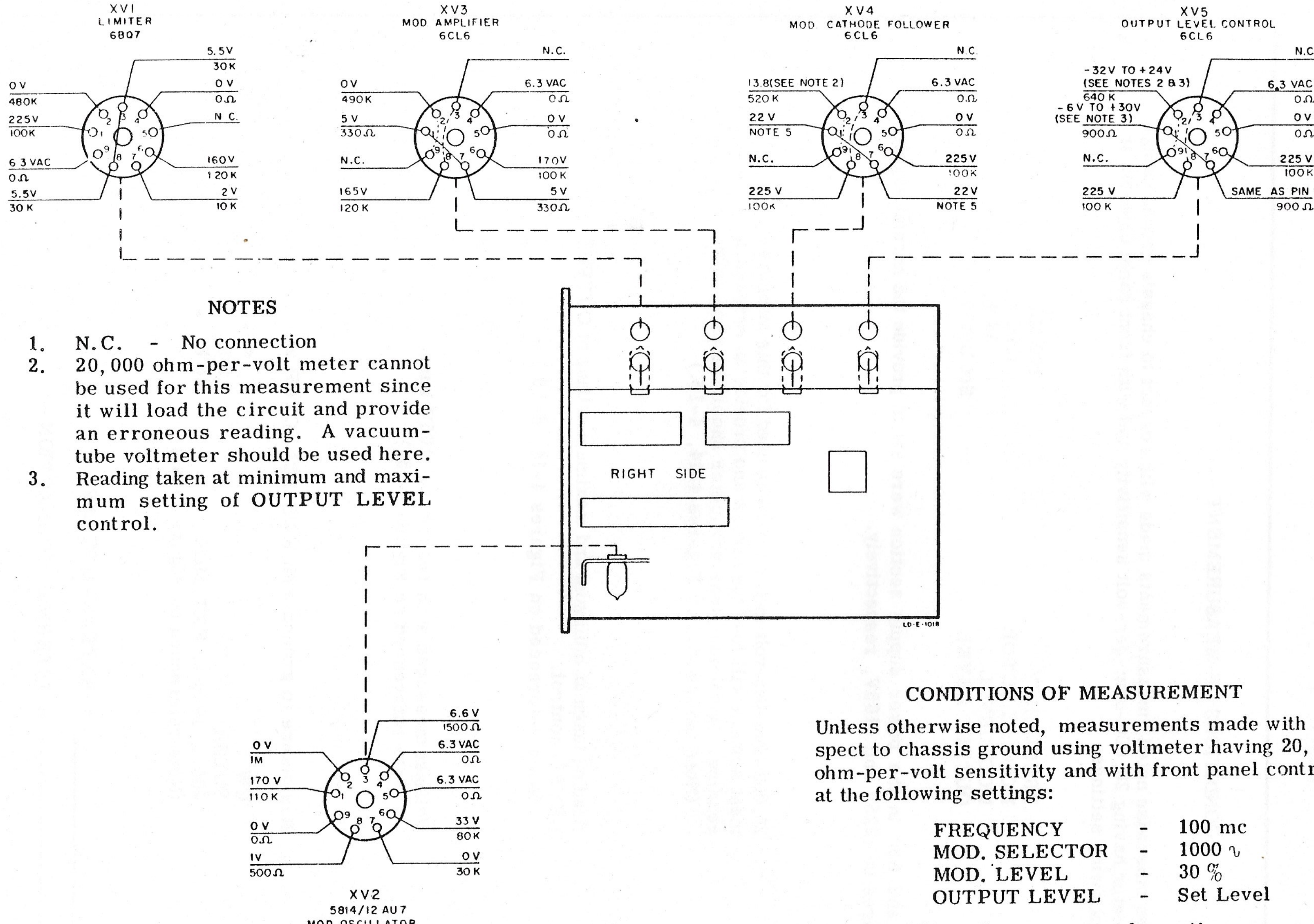
5. Resistance to ground with MOD. SELECTOR at:

CW	∞
PULSE	2 K
400 ∿, 1000 ∿, EXT. MOD.	28 K

(Note referenced on Figure 4-14.)

____________________ = EXTERNAL STRAP

-------------------- = INTERNAL CONNECTION



NOTES

1. N.C. - No connection
2. 20,000 ohm-per-volt meter cannot be used for this measurement since it will load the circuit and provide an erroneous reading. A vacuum-tube voltmeter should be used here.
3. Reading taken at minimum and maximum setting of OUTPUT LEVEL control.

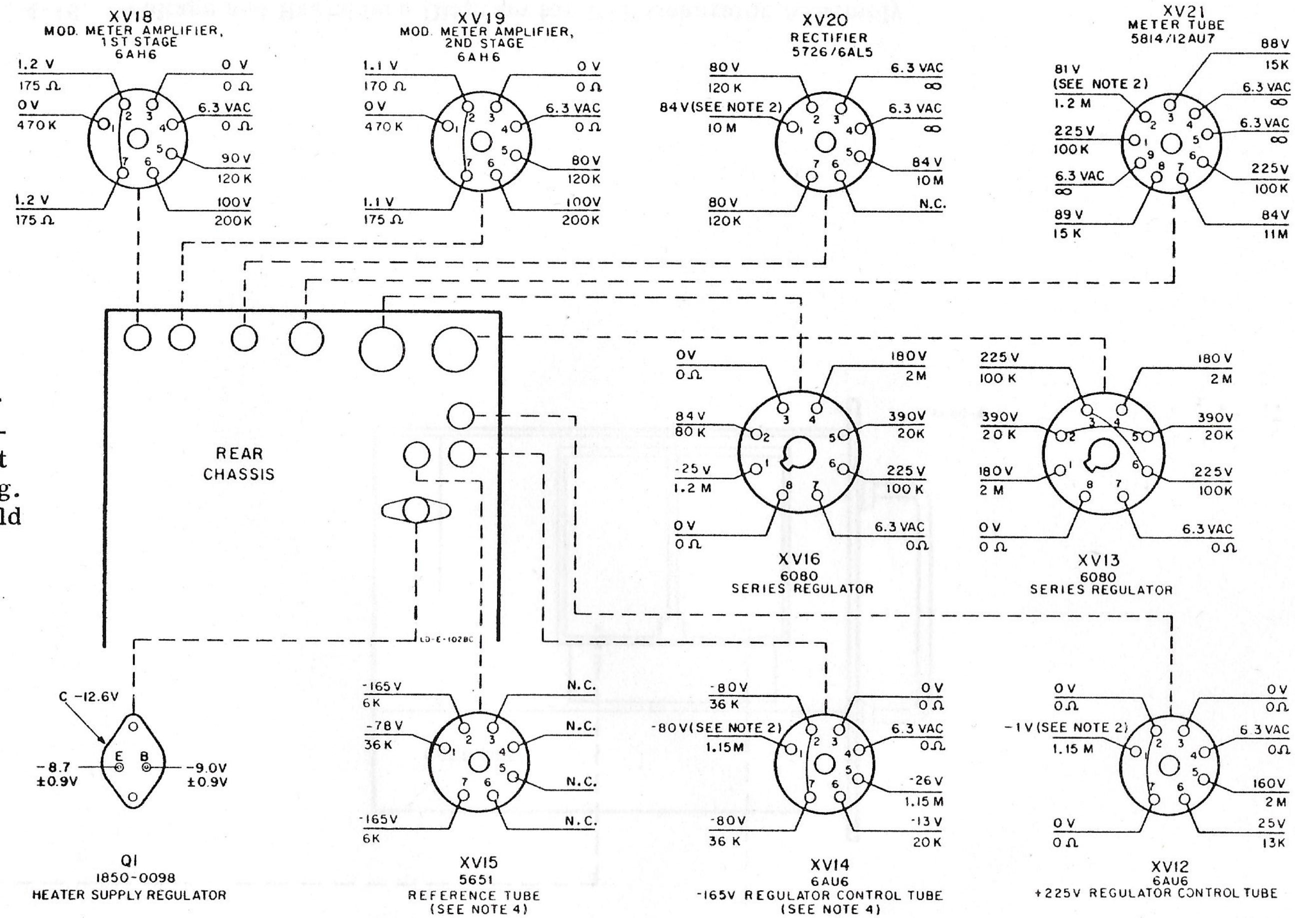
CONDITIONS OF MEASUREMENT

Unless otherwise noted, measurements made with respect to chassis ground using voltmeter having 20,000 ohm-per-volt sensitivity and with front panel controls at the following settings:

FREQUENCY	-	100 mc
MOD. SELECTOR	-	1000 ∿
MOD. LEVEL	-	30 %
OUTPUT LEVEL	-	Set Level

R71 and R80 in the power supply section were set to provide the normal supply voltages of +225V and -165V, respectively.

Figure 4-14. Voltage and Resistance Diagram for Tube Sockets Located on Right Side Chassis



NOTES

1. N.C. - No connection

2. 20,000-ohm-per-volt meter cannot be used for this measurement since it will load the circuit and provide an erroneous reading. A vacuum-tube voltmeter should be used here.

CONDITIONS OF MEASUREMENTS:

Unless otherwise noted, measurements made with respect to chassis ground using voltmeter having 20,000 ohm-per-volt sensitivity and with front panel controls at the following settings:

FREQUENCY	-	100 mc
MOD. SELECTOR	-	1000∿
MOD. LEVEL	-	30%
OUTPUT LEVEL	-	Set Level

R71 and R80 in the power supply section were set to provide the normal supply voltages of +225V and -165V, respectively.

Figure 4-15. Voltage and Resistance Diagram for Tube Sockets Located on Rear Chassis

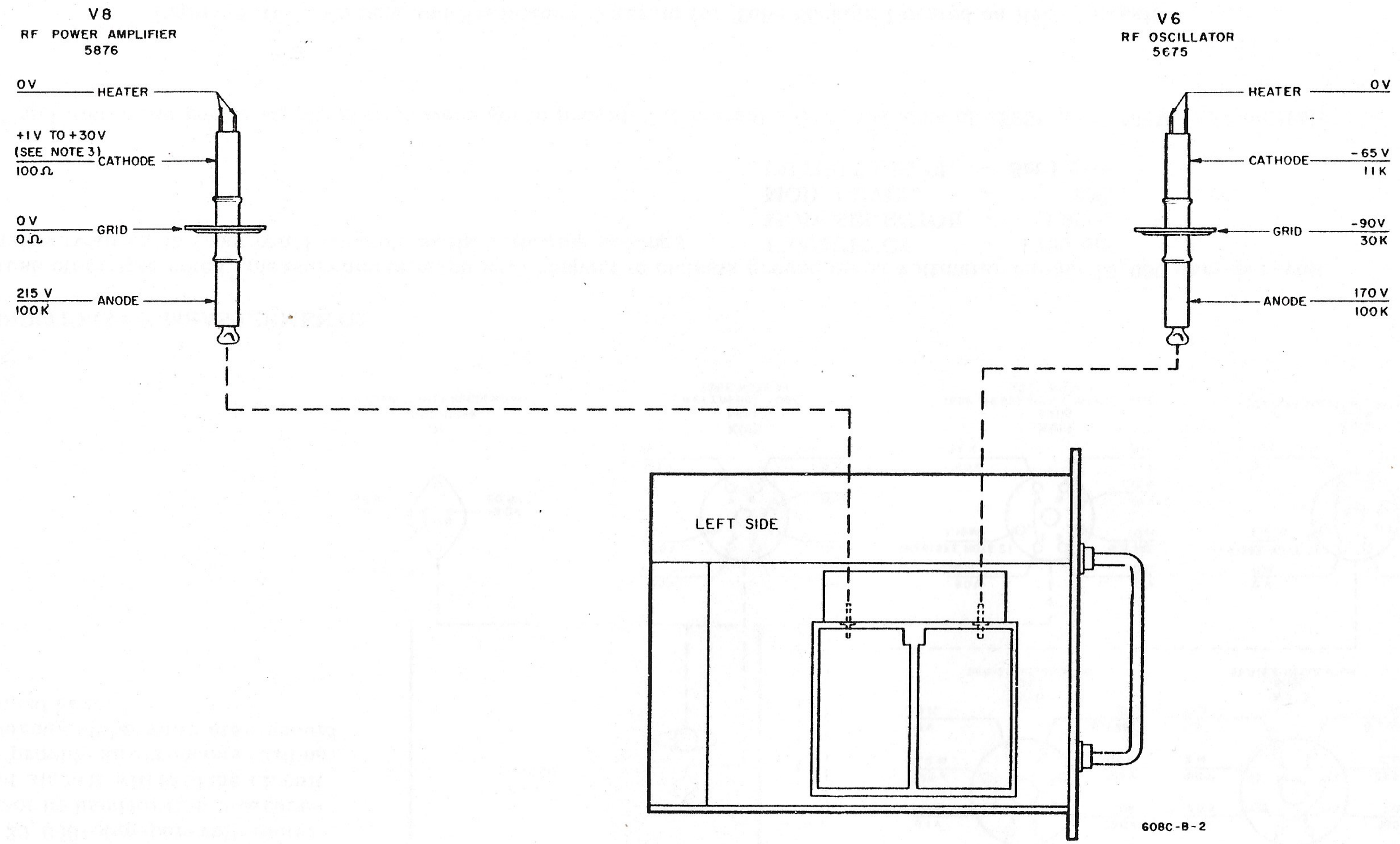
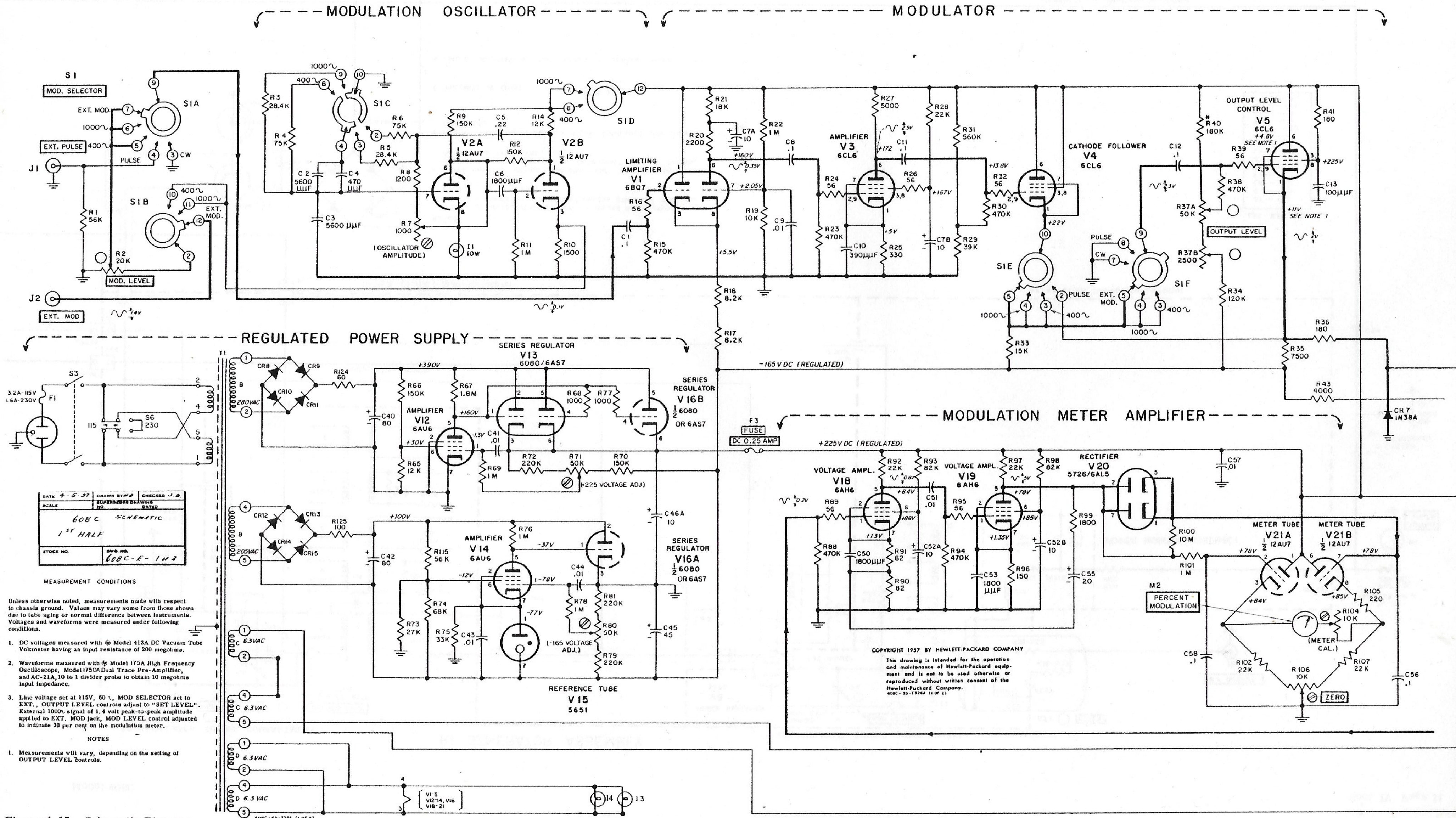


Figure 4-16. Voltage and Resistance Diagram for R-F Generator Assembly



MEASUREMENT CONDITIONS

Unless otherwise noted, measurements made with respect to chassis ground. Values may vary some from those shown due to tube aging or normal difference between instruments. Voltages and waveforms were measured under following conditions.

1. DC voltages measured with ℏp Model 412A DC Vacuum Tube Voltmeter having an input resistance of 200 megohms.
2. Waveforms measured with ℏp Model 175A High Frequency Oscilloscope, Model 1750A Dual Trace Pre-Amplifier, and AC-21A, 10 to 1 divider probe to obtain 10 megohms input impedance.
3. Line voltage set at 115V, 60 ∿, MOD SELECTOR set to EXT., OUTPUT LEVEL controls adjust to "SET LEVEL". External 1000∿ signal of 1.4 volt peak-to-peak amplitude applied to EXT. MOD jack, MOD LEVEL control adjusted to indicate 30 per cent on the modulation meter.

NOTES

1. Measurements will vary, depending on the setting of OUTPUT LEVEL controls.

Figure 4-17. Schematic Diagram (sheet 1 of 2)

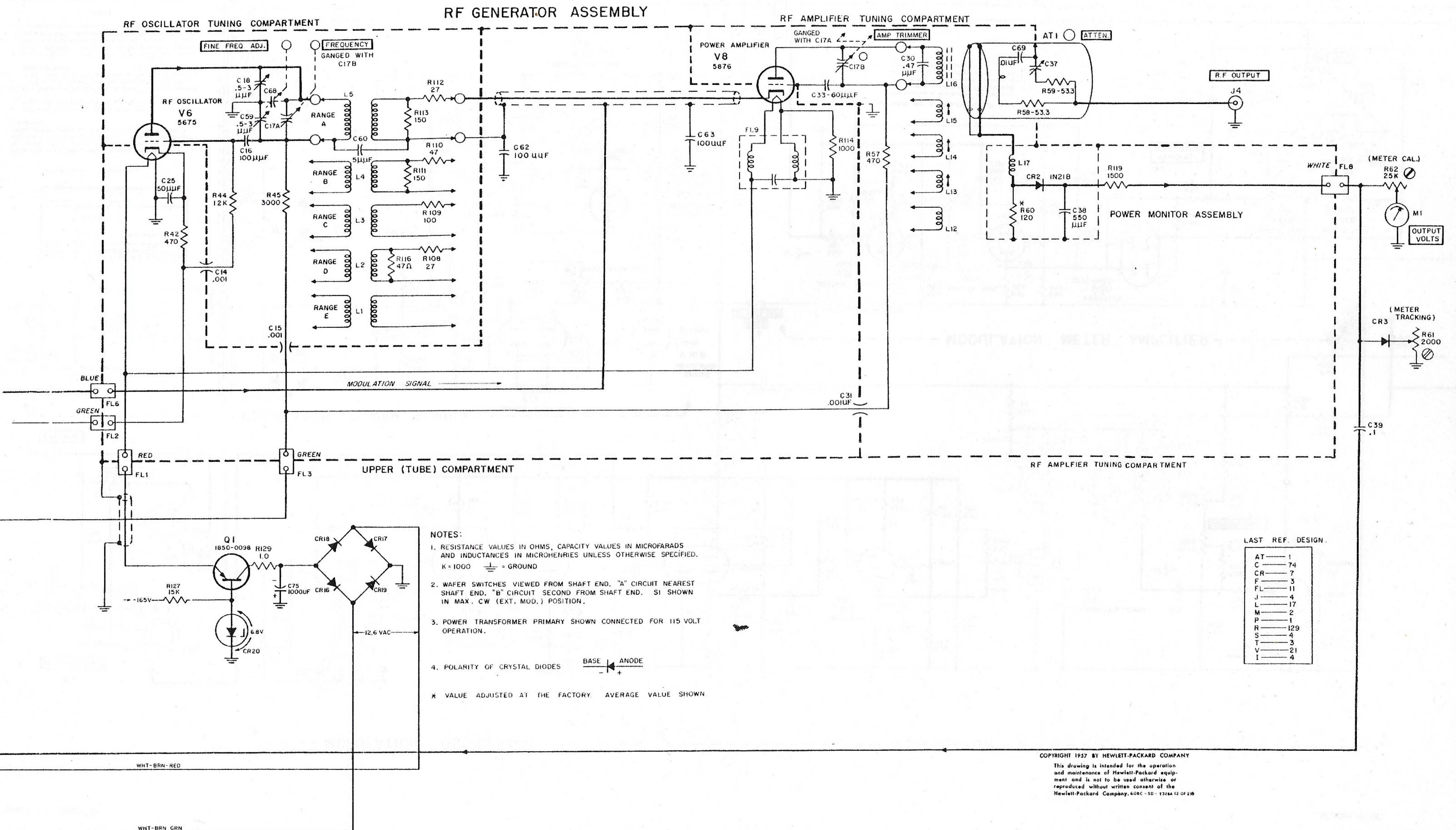


Figure 4-17. Schematic Diagram (sheet 2 of 2)

SECTION V
TABLE OF REPLACEABLE PARTS

NOTE

Standard components have been used in this instrument, whenever possible. Special components may be obtained from your local Hewlett-Packard representative or from the factory.

When ordering parts always include:

1. hp Stock Number.
2. Complete description of part including circuit reference.
3. Model number and serial number of instrument.
4. If part is not listed, give complete description, function and location of part.

Corrections to the Table of Replaceable Parts are listed on an Instruction Manual Change sheet at the front of this manual.

RECOMMENDED SPARE PARTS LIST

Column RS in the Table lists the recommended spare parts quantities to maintain one instrument for one year of isolated service. Order complete spare parts kits from the Factory Parts Sales Department. ALWAYS MENTION THE MODEL AND SERIAL NUMBERS OF INSTRUMENTS INVOLVED.

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. *	hp Stock No.	TQ	RS		
AT1	Attenuator Probe Assembly with cable and panel jack	28480	608D-34	1	1		
C1	Capacitor: fixed, paper 0.1 µf, ±10%, 400 vdcw	56289	0160-0013	7	2		
C2, 3	Capacitor: fixed, mica 5600 pf, ±10%, 500 vdcw	00656	0140-0071	2	1		
C4	Capacitor: fixed, silver mica, 470 pf, ±5 %, 500 vdcw	00853	0140-0085	1	1		
C5	Capacitor: fixed, paper, 0.22 µf, ±10%, 400 vdcw	56289	0160-0018	1	1		
C6	Capacitor: fixed, mica 1800 pf, ±10%, 500 vdcw	00853	0140-0020	3	1		
C7A, B	Capacitor: fixed, electrolytic dual section. 2 x 10 µf, 450 vdcw	14655	0180-0018	4	1		
C8	Same as C1						
C9	Capacitor: fixed, ceramic, .01 µf, ±20% 1000 vdcw	56289	0150-0012	6	2		
C10	Capacitor: fixed, mica, 390 pf, ±5%, 500 vdcw	00853	0140-0016	1	1		
C11, 12	Same as C1						
C13	Capacitor: fixed, mica, 100 pf, ±10%, 500 vdcw	00853	0140-0054	1	1		
C14, 15	Capacitor: fixed, ceramic, 1000 pf, ±20%, 500 vdcw	72982	0150-0019	3	1		
C16	Capacitor: fixed, ceramic, 100 pf, ±10%, 500 vdcw	56289	0150-0028	1	1		
C17, A, B	This capacitor is not a field replacement item						
C18	Capacitor: variable, glass 0.5-3 pf	07115	0133-0001	2	1		
C19 thru C24	Not assigned						
C25	Capacitor assembly: fixed, mica, approx. 50 pf	28480	608D-95D	2	1		

* Refer to "List of Manufacturers' Codes".
TQ Total Quantity used in the instrument.
RS Recommended spares for one year isolated service for one instrument.

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. *	hp Stock No.	TQ	RS	
C26 thru C29	Not assigned					
C30	Capacitor: fixed, titanium dioxide, .47 pf, ±5%, 500 vdcw	78488	0150-0021	1	1	
C31	Same as C14					
C32	Not assigned					
C33	Capacitor: fixed, mica, 60 pf, ±10%, 500 vdcw	28480	608D-82	1	1	
C34 thru C36	Not assigned					
C37	Part of Attenuator Assembly					
C38	Capacitor: fixed, silver mica, 550 pf, ±10%, 500 vdcw	00853	0140-0069	1	1	
C39	Same as C1					
C40	Capacitor: fixed, electrolytic, 80 μf, 450 vdcw	14655	0180-0020	2	1	
C41	Same as C9					
C42	Same as C40					
C43, 44	Same as C9					
C45	Capacitor: fixed, electrolytic, 45 μf, 450 vdcw	14655	0180-0019	1	1	
C46A	Same as C7A					
C47, 48	Not assigned					
C49	Not assigned					
C50	Same as C6					
C51	Same as C9					
C52A, B	Same as C7A					
C53	Same as C6					
C54	Not assigned					

* Refer to "List of Manufacturers' Codes".
TQ Total Quantity used in the instrument.
RS Recommended spares for one year isolated service for one instrument.

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. *	hp Stock No.	TQ	RS		
C55	Same as C7A						
C56	Same as C1						
C57	Same as C9						
C58	Same as C1						
C59	Same as C18						
C60	Capacitor: fixed, ceramic, 5 pf ±10%, 500 vdcw	04222	0150-0008	1	1		
C61	Not assigned						
C62, 63	Capacitor: fixed, mica, 100 pf ±10%, 500 vdcw	00853	0140-0077	2	1		
C64 thru C68	Not assigned						
C69	Capacitor: fixed, mylar, Part of Attenuator Probe Assembly (AT1)						
C75	Capacitor: fixed, 1000 μf	56289	0180-0057	1	1		
CR1	Not assigned						
CR2	Diode, crystal: 1N21B	96341	1900-0001	1	1		
CR3	Diode, crystal: germanium	73293	1910-0011	1	1		
CR4, 5, 6	Not assigned						
CR7	Diode, germanium: 1N38A	93332	1910-0002	1	1		
CR8 thru CR11	Diode, silicon	81483	1901-0029	4	4		
CR12 thru CR15	Diode, silicon	81483	1901-0028	4	4		
CR16 thru CR19	Diode	81483	1901-0026	4	4		
CR20	Diode, breakdown 6.8V	81483	1902-0052	1	1		
F1	Fuse, cartridge: 4 amp slow blow, 115V operation	75915	2110-0014	1	10		
	Fuse cartridge: 2 amp slow blow, 230V operation	71400	2110-0006				
F2	Not assigned						

* Refer to "List of Manufacturers' Codes".
TQ Total Quantity used in the instrument.
RS Recommended spares for one year isolated service for one instrument.

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. *	hp Stock No.	TQ	RS		
F3	Fuse, cartridge: 1/4 amp	75915	2110-0004	1	10		
FL1	Filter, R.F.: "A", red	28480	608A-27A	1	1		
FL2, 3	Filter, R.F.: "D", green	28480	608A-27D	2	1		
FL4, 5	Not assigned						
FL6	Filter, R.F.: blue	28480	608D-27C	1	1		
FL7	Not assigned						
FL8	Filter, R.F.: white	28480	608D-27B	1	1		
FL9	Filter, R.F.: choke (includes R114)	28480	608D-60M	1	1		
I1	Lamp, incandescent: 250V, 10W	24455	2140-0007	1	1		
I2	Not assigned						
I3, 4	Lamp, incandescent: 6-8V, .15 amp, #47	24455	2140-0009	2	1		
J1, 2	Connector, female: type BNC (EXT PULSE, EXT MOD)	91737	1250-0001	2	1		
J3	Not assigned						
J4	Part of Attenuator Probe Assembly (AT1)						
L1 thru L5	Part of Oscillator Turret Assembly replace as a unit						
L6 thru L11	Not assigned						
L12 thru L16	Part of Amplifier Turret Assembly replace as a unit						
L17	Part of Power Monitor Assembly						
M1	Meter, output	65092	1120-0039	1	1		
M2	Meter, modulation	65092	1120-0040	1	1		
P1	Cable, power	70903	8120-0015	1	1		
Q1	Transistor, PNP	98925	1850-0087	1	1		

* Refer to "List of Manufacturers' Codes".
TQ Total Quantity used in the instrument.
RS Recommended spares for one year isolated service for one instrument.

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. *	hp Stock No.	TQ	RS		
R1	Resistor: fixed, composition, 56,000 ohms ±10%, 1 W	01121	0690-5631	1	1		
R2	Resistor: variable, composition, 20,000 ohms ±10%, 1/3 W	71450	2100-0160	1	1		
R3	Resistor: fixed, deposited carbon, 28,400 ohms ±1%, 1/2 W	19701	0727-0184	2	1		
R4	Resistor: fixed, deposited carbon, 75,000 ohms ±1%, 1 W	19701	0730-0058	2	1		
R5	Same as R3						
R6	Same as R4						
R7	Resistor: variable, composition, 1000 ohms ± 20%	12697	2100-0036		1		
R8	Resistor: fixed, composition, 1200 ohms ± 10%, 1W	01121	0690-1221		1		
R9	Resistor: fixed, composition, 150,000 ohms ± 10% 1 W	01121	0690-1541	4	1		
R10	Resistor: fixed, composition, 1500 ohms ±10%, 1 W	01121	0690-1521	2	1		
R11	Resistor: fixed, composition, 1 megohm ±10%, 1 W	01121	0690-1051	6	2		
R12	Resistor: fixed, composition, 150,000 ohms ± 10%, 1 W	01121	0690-1541	4	1		
R13	Not assigned						
R14	Resistor: fixed, composition, 12,000 ohms ±10%, 2 W	01121	0693-1231	2	1		
R15	Resistor: fixed, composition, 470,000 ohms ±10%, 1 W	01121	0690-4741	4	1		
R16	Resistor: fixed, composition, 56 ohms ±10%, 1/2 W	01121	0687-5601	7	2		
R17, 18	Resistor: fixed, composition, 8200 ohms ±10%, 2 W	01121	0693-8221	2	1		
R19	Resistor: fixed, composition, 10,000 ohms ±10%, 1 W	01121	0690-1031	1	1		

* Refer to "List of Manufacturers' Codes".
TQ Total Quantity used in the instrument.
RS Recommended spares for one year isolated service for one instrument.

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. *	hp Stock No.	TQ	RS		
R20	Resistor: fixed, composition, 2200 ohms ±10%, 2 W	01121	0693-2221	1	1		
R21	Resistor: fixed, composition, 18,000 ohms ±10% 2 W	01121	0693-1831	1	1		
R22	Same as R11						
R23	Same as R15						
R24	Same as R16						
R25	Resistor: fixed, composition, 330 ohms ±10%, 1 W	01121	0690-3311	1	1		
R26	Same as R16						
R27	Resistor: fixed, wirewound, 5000 ohms ±1%, 5 W	91637	0811-0006	1	1		
R28	Resistor: fixed, composition, 22,000 ohms ±10%, 2 W	01121	0693-2231	5	2		
R29	Resistor: fixed, composition, 39,000 ohms ±10%, 1 W	01121	0690-3931	1	1		
R30	Same as R15						
R31	Resistor: fixed, composition, 560,000 ohms ±10%, 1 W	01121	0690-5641	1	1		
R32	Same as R16						
R33	Resistor: fixed, wirewound, 15,000 ohms ±10%, 10 W	35434	0816-0013	1	1		
R34	Resistor: fixed, composition, 120,000 ohms ±10%, 1 W	01121	0690-1241	1	1		
R35	Resistor: fixed, wirewound, 7500 ohms ±5%, 20 W	35434	0818-0009	1	1		
R36	Resistor: fixed, composition, 180 ohms ±10%, 1 W	01121	0690-1811	1	1		
R37A, B	Resistor: variable, carbon, 2 sections, 2000-50,000 ohms	12697	2100-0052	1	1		
R38	Same as R15						
R39	Same as R16						

* Refer to "List of Manufacturers' Codes".
TQ Total Quantity used in the instrument.
RS Recommended spares for one year isolated service for one instrument.

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. *	Stock No.	TQ	RS		
R40	Resistor: fixed, composition, 180,000 ohms ±10%, 1 W Optimum value selected at factory Average value shown	01121	0690-1841	1	1		
R41	Resistor: fixed, composition, 180 ohms ±10%, 1/2 W	01121	0687-1811	1	1		
R42	Resistor: fixed, composition, 470 ohms ±10%, 2 W	01121	0693-4711	1	1		
R43	Resistor: fixed, wirewound, 4000 ohms ±10%, 10 W	35434	0815-0003	1	1		
R44	Same as R14						
R45	Resistor: fixed, wirewound, 3000 ohms ±10%, 10 W	35434	0816-0002	1	1		
R46 thru R56	Not assigned						
R57	Resistor: fixed, composition, 470 ohms ±10%, 1 W	01121	0690-4711	1	1		
R58, 59	Resistor: fixed, deposited carbon, 53.3 ohms ±1%, 1/8 W part of Attenuator Assembly	19701	0721-0006	2	1		
R60	Resistor: fixed, composition, 120 ohms ±10%, 1/4 W Optimum value selected at factory Average value shown	01121	0684-1211	1	1		
R61	Same as R7						
R62	Resistor: variable, composition, 25,000 ohms ±20%, 1 W	71590	2100-0009	1	1		
R63, 64	Not assigned						
R65	Resistor: fixed, composition, 12,000 ohms ±10%, 1 W	01121	0690-1231	1	1		
R66	Same as R9						
R67	Resistor: fixed, composition, 1.8 megohms ±10%, 1 W	01121	0690-1851	1	1		
R68	Same as R8						
R69	Same as R11						

* Refer to "List of Manufacturers' Codes".
TQ Total Quantity used in the instrument.
RS Recommended spares for one year isolated service for one instrument.

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. *	hp Stock No.	TQ	RS		
R70	Same as R9						
R71	Resistor: variable, composition, 50,000 ohms ±20%, 1/3 W	71450	2100-0157	2	1		
R72	Resistor: fixed, composition, 220,000 ohms ±10%, 1 W	01121	0690-2241	3	1		
R73	Resistor: fixed, composition, 27,000 ohms ±10%, 1 W	01121	0690-2731	1	1		
R74	Resistor: fixed, composition, 68,000 ohms ±10%, 2 W	01121	0693-6831	1	1		
R75	Resistor: fixed, composition, 33,000 ohms ±10%, 1 W	01121	0690-3331	3	1		
R76	Same as R11						
R77	Same as R8						
R78	Same as R11						
R79	Same as R72						
R80	Same as R71						
R81	Same as R72						
R82	Not assigned						
R83	Not assigned						
R84, 85	Not assigned						
R86	Not assigned						
R87	Not assigned						
R88	Resistor: fixed, composition, 470,000 ohms ±10%, 1/2 W	01121	0687-4741	2	1		
R89	Same as R16						
R90, 91	Resistor: fixed, composition, 82 ohms ±10%, 1 W	01121	0690-8201	2	1		
R92	Same as R28						
R93	Resistor: fixed, composition, 82,000 ohms ±10%, 1 W	01121	0690-8231	2	1		

* Refer to "List of Manufacturers' Codes".
TQ Total Quantity used in the instrument.
RS Recommended spares for one year isolated service for one instrument.

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. *	hp Stock No.	TQ	RS		
R94	Same as R88						
R95	Same as R16						
R96	Resistor: fixed, composition, 150 ohms ±10%, 1 W	01121	0690-1511	1	1		
R97	Same as R28						
R98	Same as R93						
R99	Resistor: fixed, composition, 1800 ohms ±10%, 1 W	01121	0690-1821	1	1		
R100	Resistor: fixed, composition, 10 megohms ±10%, 1 W	01121	0690-1061	1	1		
R101	Same as R11						
R102	Same as R28						
R103	Not assigned						
R104	Resistor: variable, composition, linear taper, 10,000 ohms ±20%, 1/2 W	71450	2100-0156	2	1		
R105	Resistor: fixed, composition, 220 ohms ±10%, 1 W	01121	0690-2211	1	1		
R106	Same as R104						
R107	Same as R28						
R108	Resistor: fixed, composition, 27 ohms ±10%, 1/4 W	01121	0684-2701	2	1		
R109	Resistor: fixed, composition, 100 ohms ±10%, 1/4 W	01121	0684-1011	1	1		
R110	Resistor: fixed, composition, 47 ohms ±10%, 1/4 W	01121	0684-4701	2	1		
R111	Resistor: fixed, composition, 150 ohms ±10%, 1/4 W	01121	0684-1511	2	1		
R112	Same as R108						
R113	Same as R111						
R114	Resistor: fixed, 1000 ohms Part of FL9						
R115	Same as R1						

* Refer to "List of Manufacturers' Codes".
TQ Total Quantity used in the instrument.
RS Recommended spares for one year isolated service for one instrument.

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. *	ⓗⓟ Stock No.	TQ	RS		
R116 thru R118	Not assigned						
R119	Same as R10						
R120	Resistor: fixed, composition, 1000 ohms ±10%, 2 W	01121	0693-1021	1	1		
R121 thru R123	Not assigned						
R124	Resistor: fixed, wirewound, 60 ohms ±5%, 4 W	35434	0818-0027	1	1		
R125	Resistor: fixed, wirewound, 100 ohms ±10%, 20 W	35434	0819-0019	1	1		
R126	Same as R110						
R127	Resistor: fixed, composition 15, 000 ohms	19701	0773-0006	1	1		
R128	Not assigned						
R129	Resistor: fixed WW 1 ohm ± 5%, 3 W		0813-0029	1	1		
S1	Switch, rotary: 5 position	76854	3100-0097	1	1		
S2	Not assigned						
S3	Switch, toggle: DPST	04009	3101-0003	1	1		
S6	Switch, slide: DPDT		3101-0033	1	1		
T1	Transformer, power	28480	9100-2289	1	1		
V1	Tube, electron: 6BQ7A	86684	1932-0021	1	1		
V2	Tube, electron: 12AU7	33173	1932-0029	2	2		
V3, 4, 5	Tube, electron: 6CL6	82219	1923-0030	3	3		
V6	Tube, electron: 5675	86684	1921-0001	1	1		
V7	Not assigned						
V8	Tube, electron: 5876	86684	1921-0002	1	1		
V9 thru V11	Not assigned						
V12	Tube, electron: 6AU6	86684	1923-0021	2	2		
V13	Tube, electron: 6080	86684	1932-0010	2	2		
V14	Same as V12						
V15	Tube, electron: 5651	86684	1940-0001	1	1		

* Refer to "List of Manufacturers' Codes".
TQ Total Quantity used in the instrument.
RS Recommended spares for one year isolated service for one instrument.

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. *	hp Stock No.	TQ	RS		
V16	Same as V13						
V17	Not assigned						
V18,19	Tube, electron: 6AH6	33173	1923-0017	2	2		
V20	Tube, electron: 6AL5	33173	1930-0013	1	1		
V21	Same as V2						
	MISCELLANEOUS						
	Attenuator, knob and dial assembly	28480	608C-40A	1	1		
	Attenuator, drive pulley	28480	608D-34F	1	1		
	Attenuator drive cable: 36 in. long	28480	G-18B	1	1		
	Body, oscillator, tube socket	28480	608D-59A-3	1	1		
	Power monitor assembly	28480	608D-95A	1	1		
	Capacitor Assembly, attenuator	28480	608A-95B	1	1		
	Cam, frequency adjust	28480	608D-59H	1	1		
	Clip, for Power Monitor rectifier	28480	608A-28C	1	1		
	Contact Assembly: for oscillator pick-up coil	28480	608D-100K	1	1		
	Center, contact, female, for output connector	91737	1250-0017	1	1		
	Contact, oscillator grid	28480	608A-100V	1	1		
	Contact, oscillator tube socket	28480	608D-59A-2	1	1		
	Contact, amplifier cathode	28480	608A-100W	1	1		
	Crank, handle	28480	G-74AE	1	1		
	Coupler, flexible, bellows type	28480	G-32K	1	1		
	Detent arm, range switch	28480	608D-59C	1	1		
	Fuseholder	75915	1400-0084	2	1		
	Gear, frequency stop	28480	G-24C-2	1	1		
	Gear, worm, oscillator drive	28480	608D-24A	1	1		

* Refer to "List of Manufacturers' Codes".
TQ Total Quantity used in the instrument.
RS Recommended spares for one year isolated service for one instrument.

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. *	hp Stock No.	TQ	RS		
	Gear, frequency drive	28480	608D-37B	1	1		
	Holder, lamp (I 1)	95263	1450-0013	1	1		
	Holder, lamp (I3)	95263	1450-0012	1	1		
	Holder, lamp (panel)	72619	1450-0027	1	1		
	Insulator, card, attenuator	28480	608A-34C	1	1		
	Insulator, standoff, cylindrical shape	72656	0340-0020	2	1		
	Insulator, shoulder bushing	72656	0340-0005	2	1		
	Insulator, standoff, cylindrical shape, 1/2 in. long x 1/2 in. dia.	71590	0340-0007	1	1		
	Insulator, standoff, .625 in. long	71590	0340-0006	8	2		
	Knob: OUTPUT LEVEL	28480	G-74B	1	1		
	Knob: OUTPUT LEVEL, skirted	28480	G-74L	1	1		
	Knob: FINE FREQ. ADJUST	28480	G-74D	1	1		
	Knob: MOD. LEVEL AMP TRIMMER	28480	G-74F	2	1		
	Knob: MOD. SELECTOR, FREQ. RANGE	28480	G-74N	1	1		
	Knob: FREQ RANGE	28480	G-74AD	1	1		
	Roller, detent	28480	608D-59D	1	1		
	Spring, lock	28480	1460-0013	1	1		
	Screw, captive, for cabinet with knurled head	28480	608D-44K	1	1		
	Spacer, bakelite oscillator tube	28480	608D-59A-4	1	1		
	Washer, oscillator tube	28480	608A-88	1	1		
	Spring, detent	28480	608D-59C	1	1		
	Shaft, amplifier drive	28480	608D-37A	1	1		
	Shaft, frequency vernier, bakelite	28480	608D-37P	1	1		
	Socket, for Power Monitor crystals	28480	608A-28D	1	1		
	Socket, for pencil triode filament	28480	1200-0010	1	1		

* Refer to "List of Manufacturers' Codes".
TQ Total Quantity used in the instrument.
RS Recommended spares for one year isolated service for one instrument.

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. *	hp Stock No.	TQ	RS		
	Turret Assembly: Amplifier	28480	608C-60A	1	1		
	Turret Assembly: Oscillator	28480	608C-60B	1	1		
	Wrench, spanner	28480	612A-38A	1	1		
	Window, dial: for attenuator dial	28480	G-99M	1	1		
	Window, frequency dial	28480	608C-83C	1	1		

* Refer to "List of Manufacturers' Codes".
TQ Total Quantity used in the instrument.
RS Recommended spares for one year isolated service for one instrument.

APPENDIX I
CODE LIST OF MANUFACTURERS (Sheet 1 of 2)

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 handbooks.

CODE NO.	MANUFACTURER	ADDRESS
00334	Humidial Co.	Colton, Calif.
00335	Westrex Corp.	New York, N.Y.
00373	Garlock Packing Co., Electronic Products Div.	Camden, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp, Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00853	Sangamo Electric Company, Ordill Division (Capacitors)	Marion, Ill.
00866	Goe Engineering Co.	Los Angeles, Calif.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	Pacific Semiconductors, Inc.	Culver City, Calif.
01295	Texas Instruments, Inc. Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01561	Chassi-Trak Corp.	Indianapolis, Ind.
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01930	Amerock Corp.	Rockford, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02286	Cole Mfg. Co.	Palo Alto, Calif.
02660	Amphenol-Borg Electronics Corp.	Chicago, Ill.
02735	Radio Corp. of America Semiconductor and Materials Div.	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
03508	G.E. Semiconductor Products Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	El Monte, Calif.
03877	Transitron Electronic Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co.	Morristown, N.J.
03954	Air Marine Motors, Inc.	Los Angeles, Calif.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04062	Elmenco Products Co.	New York, N.Y.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04298	Elgin National Watch Co., Electronics Division	Burbank, Calif.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Prods., Inc. Electronic Tube Div.	Mountain View, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Western Division	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Ill.
04870	P M Motor Co.	Chicago, Ill.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05277	Westinghouse Electric Corp., Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05593	Illumitronic Engineering Co.	Sunnyvale, Calif.
05624	Barber Colman Co.	Rockford, Ill.
05729	Metropolitan Telecommunications Corp., Metro Cap. Div.	Brooklyn, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
06004	The Bassick Co.	Bridgeport, Conn.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
07115	Corning Glass Works Electronic Components Dept.	Bradford, Pa.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.
07261	Avnet Corp.	Los Angeles, Calif.
07263	Fairchild Semiconductor Corp.	Mountain View, Calif.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Rheem Semiconductor Corp.	Mountain View, Calif.
07980	Boonton Radio Corp.	Boonton, N.J.
08145	U.S. Engineering Co.	Los Angeles, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08717	Sloan Company	Burbank, Calif.
08718	Cannon Electric Co. Phoenix Div.	Phoenix, Ariz.
08792	CBS Electronics Semiconductor Operations, Div. of C.B.S. Inc.	Lowell, Mass.
09026	Babcock Relays, Inc.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09250	Electro Assemblies, Inc.	Chicago, Ill.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
10214	General Transistor Western Corp.	Los Angeles, Calif.
10411	Ti-Tal, Inc.	Berkeley, Calif.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.
11312	Microwave Electronics Corp.	Palo Alto, Calif.
11711	General Instrument Corporation Semiconductor Division	Newark, N.J.
11717	Imperial Electronics, Inc.	Buena Park, Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12697	Clarostat Mfg. Co.	Dover, N.H.
14655	Cornell Dubilier Elec. Corp.	So. Plainfield, N.J.
15909	The Daven Co.	Livingston, N.J.
16688	De Jur-Amsco Corporation	Long Island City 1, N.Y.
16758	Delco Radio Div. of G. M. Corp.	Kokomo, Ind.
18873	E. I. DuPont and Co., inc.	Wilmington, Del.
19315	Eclipse Pioneer, Div. of Bendix Aviation Corp.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.
19701	Electra Manufacturing Co.	Kansas City, Mo.
20183	Electronic Tube Corp.	Philadelphia, Pa.
21520	Fansteel Metallurgical Corp.	No. Chicago, Ill.
21335	The Fafnir Bearing Co.	New Britain, Conn.
21964	Fed. Telephone and Radio Corp.	Clifton, N.J.
24446	General Electric Co.	Schenectady, N.Y.
24455	G.E., Lamp Division	Nela Park, Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
37942	P. R. Mallory & Co., Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43990	C. A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer and Inst. Co.	Philadelphia, Pa.
49956	Raytheon Company	Lexington, Mass.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Sorenson & Co., Inc.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
59446	Telex, Inc.	St. Paul, Minn.
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Swissvale, Pa.
62119	Universal Electric Co.	Owosso, Mich.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Div. of Daystrom, Inc.	Newark, N.J.
66346	Wollensak Optical Co.	Rochester, N.Y.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control Co., Inc.	New York, N.Y.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	New York, N.Y.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio Inc.	Cleveland, Ohio
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Allen D. Cardwell Electronic Prod. Corp.	Plainville, Conn.
71400	Bussmann Fuse Div. of McGraw-Edison Co.	St. Louis, Mo.
71450	CTS Corp.	Elkhart, Ind.
71468	Cannon Electric Co.	Los Angeles, Calif.
71471	Cinema Engineering Co.	Burbank, Calif.
71482	C. P. Clare & Co.	Chicago, Ill.
71528	Standard-Thomson Corp., Clifford Mfg. Co. Div.	Waltham, Mass.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71700	The Cornish Wire Co.	New York, N.Y.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71753	A. O. Smith Corp., Crowley Div.	West Orange, N.J.
71785	Cinch Mfg. Corp.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
72354	John E. Fast & Co.	Chicago, Ill.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	General Ceramics Corp.	Keasbey, N.J.
72758	Girard-Hopkins	Oakland, Calif.
72765	Drake Mfg. Co.	Chicago, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72982	Erie Resistor Corp.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73138	Helipot Div. of Beckman Instruments, Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Electronic Co., Div. of North American Phillips Co., Inc.	Hicksville, N.Y.
73506	Bradley Semiconductor Corp.	Hamden, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73682	George K. Garrett Co., Inc.	Philadelphia, Pa.
73734	Federal Screw Products Co.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	The General Industries Co.	Elyria, Ohio
73905	Jennings Radio Mfg. Co.	San Jose, Calif.
74455	J. H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.

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H4-2 Dated December 1961

APPENDIX I
CODE LIST OF MANUFACTURERS (Sheet 2 of 2)

CODE NO.	MANUFACTURER	ADDRESS
74868	R.F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E. F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75173	Jones, Howard B., Division of Cinch Mfg. Corp.	Chicago, Ill.
75378	James Knights Co.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littelfuse Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C. W. Marwedel	San Francisco, Calif.
76433	Micamold Electronic Mfg. Corp.	Brooklyn, N.Y.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J. W. Miller Co.	Los Angeles, Calif.
76530	Monadnock Mills	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio
76854	Oak Manufacturing Co.	Chicago, Ill.
77068	Bendix Pacific Division of Bendix Corp.	No. Hollywood, Calif.
77221	Phaostron Instrument and Electronic Co.	South Pasadena, Calif.
77342	Potter and Brumfield, Div. of American Machine and Foundry	Princeton, Ind.
77630	Radio Condenser Co.	Camden, N.J.
77638	Radio Receptor Co., Inc.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78283	Signal Indicator Corp.	New York, N.Y.
78471	Tilley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	Pasadena, Calif.
78947	Ucinite Co.	Newtonville, Mass.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80120	Schnitzer Alloy Products	Elizabeth, N.J.
80130	Times Facsimile Corp.	New York, N.Y.
80131	Electronic Industries Association Any brand tube meeting EIA standards	Washington, D.C.
80207	Unimax Switch, Div. of W. L. Maxson Corp.	Wallingford, Conn.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Laboratories, Inc.	Riverside, Calif.
80411	Acro Div. of Robertshaw Fulton Controls Co.	Columbus 16, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80583	Hammerlund Co., Inc.	New York, N.Y.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
81030	International Instruments, Inc.	New Haven, Conn.
81415	Wilkor Products, Inc.	Cleveland, Ohio
81453	Raytheon Mfg. Co., Industrial Components Div., Industr. Tube Operations	Newton, Mass.
81483	International Rectifier Corp.	El Segundo, Calif.
81860	Barry Controls, Inc.	Watertown, Mass.
82042	Carter Parts Co.	Skokie, Ill.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Allen B. DuMont Labs., Inc.	Clifton, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc., Electronic Tube Div.	Emporium, Pa.
82376	Astron Co.	East Newark, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals and Controls, Inc., Div. of Texas Instruments, Inc., Spencer Prods.	Attleboro, Mass.
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Manufacturing Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83053	Western Washer Mfr. Co.	Los Angeles, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	Pyramid Electric Co.	Darlington, S.C.
83148	Electro Cords Co.	Los Angeles, Calif.
83186	Victory Engineering Corp.	Union, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83501	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp., Electronic Tube Div.	Plainfield, N.J.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
84171	Arco Electronics, Inc.	New York, N.Y.
84396	A. J. Glesener Co., Inc.	San Francisco, Calif.
84411	Good All Electric Mfg. Co.	Ogallala, Neb.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85474	R. M. Bracamonte & Co.	San Francisco, Calif.
85660	Koiled Kords, Inc.	New Haven, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86197	Clifton Precision Products	Clifton Heights, Pa.
86684	Radio Corp. of America, RCA Electron Tube Div.	Harrison, N.J.
87216	Philco Corp. (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
89473	General Electric Distributing Corp.	Schenectady, N.Y.
89636	Carter Parts Div. of Economy Baler Co.	Chicago, Ill.
89665	United Transformer Co.	Chicago, Ill.
90179	U.S. Rubber Co., Mechanical Goods Div.	Passaic, N.J.
90970	Bearing Engineering Co.	San Francisco, Calif.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Brothers,'Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Philadelphia, Pa.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Calif.
91921	Minneapolis-Honeywell Regulator Co., Micro-Switch Division	Freeport, Ill.
92196	Universal Metal Products, Inc.	Bassett Puente, Calif.
93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.
93369	Robbins and Myers, Inc.	New York, N.Y.
93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio
93983	Insuline-Van Norman Ind., Inc. Electronic Division	Manchester, N.H.
94144	Raytheon Mfg. Co., Industrial Components Div., Receiving Tube Operation	Quincy, Mass.
94145	Raytheon Mfg. Co., Semiconductor Div., California Street Plant	Newton, Mass.
94148	Scientific Radio Products, Inc.	Loveland, Colo.
94154	Tung-Sol Electric, Inc.	Newark, N.J.
94197	Curtiss-Wright Corp., Electronics Div.	East Paterson, N.J.
94310	Tru Ohm Prod. Div. of Model Engineering and Mfg. Co.	Chicago, Ill.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
95236	Allies Products Corp.	Miami, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	New York, N.Y.
95264	Lerco Electronics, Inc.	Burbank, Calif.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95354	Methode Mfg. Co.	Chicago, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Huggins Laboratories	Sunnyvale, Calif.
96095	Hi-Q Division of Aerovox	Olean, N.Y.
96256	Thordarson-Meissner Div. of Maguire Industries, Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic and Precision Mfg. Co.	Yonkers, N.Y.
97966	CBS Electronics, Div. of C.B.S., Inc.	Danvers, Mass.
98141	Axel Brothers Inc.	Jamaica, N.Y.
98220	Francis L. Mosley	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98405	Carad Corp.	Redwood City, Calif.
98734	Palo Alto Engineering Co., Inc.	Palo Alto, Calif.
98821	North Hills Electric Co.	Mineola, N.Y.
98925	Clevite Transistor Prod. Div. of Clevite Corp.	Waltham, Mass.
98978	International Electronic Research Corp.	Burbank, Calif.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
99515	Marshall Industries, Electron Products Division	Pasadena, Calif.
99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99934	Renbrandt, Inc.	Boston, Mass.
99942	Hoffman Semiconductor Div. of Hoffman Electronics Corp.	Evanston, Ill.
99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.

THE FOLLOWING H-P VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

0000F	Malco Tool and Die	Los Angeles, Calif.
0000I	Telefunken (c/o American Elite)	New York, N.Y.
0000L	Winchester Electronics, Inc.	Santa Monica, Calif.
0000M	Western Coil Div. of Automatic Ind., Inc.	Redwood City, Calif.
0000N	Nahm-Bros. Spring Co.	San Leandro, Calif.
0000P	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
0000T	Texas Instruments, Inc. Metals and Controls Div.	Versailles, Ky.
0000U	Tower Mfg. Corp.	Providence, R.I.
0000W	Webster Electronics Co. Inc.	New York, N.Y.
0000X	Spruce Pine Mica Co.	Spruce Pine, N.C.
0000Y	Midland Mfg. Co. Inc.	Kansas City, Kans.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AA	British Radio Electronics Ltd.	Washington, D.C.
000BB	Precision Instrument Components Co.	Van Nuys, Calif.
000CC	Computer Diode Corp.	Lodi, N.J.
000EE	A. Williams Manufacturing Co.	San Jose, Calif.
000FF	Carmichael Corrugated Specialties	Richmond, Calif.
000GG	Goshen Die Cutting Service	Goshen, Ind.
000HH	Rubbercraft Corp.	Torrance, Calif.
000II	Birtcher Corporation, Industrial Division	Monterey Park, Calif.

00015-21
Revised: 7 February 1962

From: F.S.C. Handbook Supplements
H4-1 Dated December 1961
H4-2 Dated December 1961

APPENDIX II

MANUAL CHANGES

AII-1. This section contains information for adapting this manual to instruments for which the content does not apply directly.

AII-2. To adapt this manual to your instrument, refer to the table below and make all of the manual changes listed opposite your instrument serial number. Perform the changes in the sequence listed.

Instrument Serial Number	Changes
1 to 313	O thru A
314 to 1287	O thru B
369-1288 to 369-2594	O thru C
004-2595 to 004-2664	O thru C
010-02665 to 010-03809	O thru D
202-03810 to 202-04755	O thru E
247-04756 to 247-05017	O thru F
310-05018 to 310-05209	O thru G
326-	O thru H
449	O thru I
449-06198 to 449-06257	O thru J
525-06258 to 525-06282	O thru J
538-06283 to 538-06334	O thru K
548-06335 to 548-06809	O thru L
637-06810 to 637-07364	O, N, M
832-07365 to 832-07414	O, N
832-07415 to 832-07539	O
832-07540 and above	Manual Applies

CHANGE A

On Figure 4-17 and Parts List:
- S3: Connect one pole in series with T1 terminal A2 instead of T1A1.
- CR7: Change physical location to inside the r-f generator housing
- I3: Change circuit location to T1 terminals C4 and C5
- Delete R120 and replace with a wire jumper.
- Delete C68.

CHANGE B

On Figure 4-17 and Parts List:
- Change R43 to 5000 ohms and physical location to be inside the r-f generator assembly in series with lead from FL2.
- Delete R115.
- Change CR8, 9, 10, 11 to CR4, CR5, each a 2-section rectifier with HP Stock No. 212-104.
- Delete R124 and replace with a wire jumper.
- Change CR12, 13, 14, 15 to CR6, a full-wave bridge rectifier with HP Stock No. 212-103.
- Delete R125 and replace with a wire jumper.

CHANGE C

On Figure 4-17 and Parts List:
Change
V6: Tube electron: Stock No. 1921-0001 may be marked 5675, HP4042, or 1921-0001.
V8: Tube electron: Stock No. 1921-0002 may be marked 5876, HP4043, or 1921-0002.

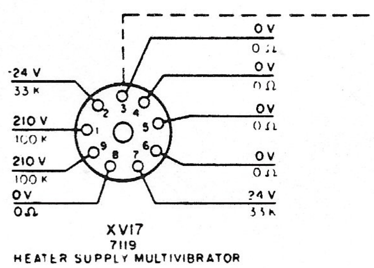
CR8 through CR11: Change to diode, silicon: HP Stock No. 1901-0029.
CR12 through CR15: Change to diode, silicon: HP Stock NO. 1901-0028.

CHANGE D

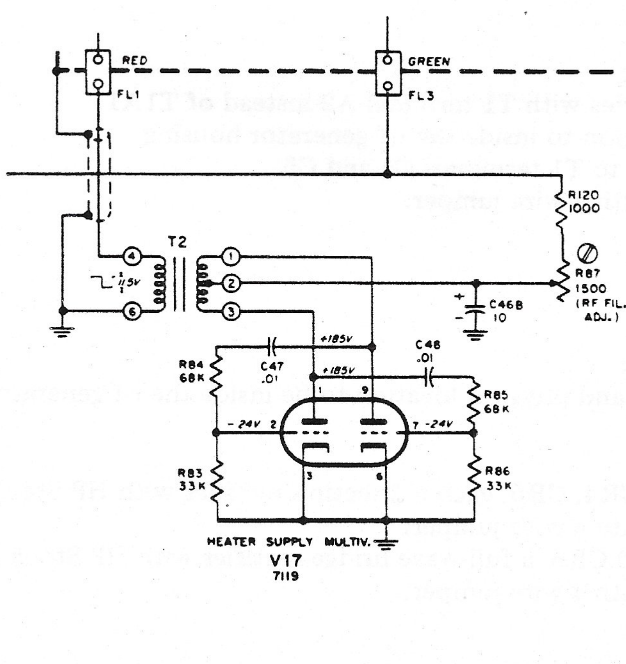
On Figures 3-7 and 4-17 and Parts List:
Change I1 to 120V, 3W, Stock No. 2140-0001.
Change R8 to 1000 ohms, 10%, 1W, Stock No. 0690-1021.

CHANGE E

On Figure 4-17 and Parts List:
Replace RF tube heater supply circuit (Q1 and associated components) with the multivibrator circuit as follows:

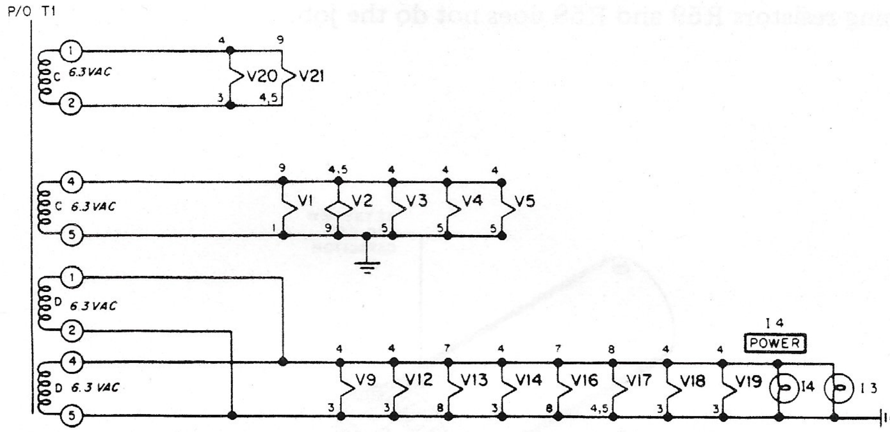


On Figure 4-15
Change socket for Q1 to socket for V17 as follows:



CHANGE E (Cont'd)

On Figure 4-17
Change the Schematic to show the heater wiring as follows:



On Parts List
Delete: C75, CR16-20, Q1, R127, R128
Add the following parts:

C46:	Capacitor: fixed, electrolytic, 45μf, 450 vdcw, HP Stock No. 18-33.
C47, 48:	Capacitor: fixed, paper dielectric, 01μf, ± 10%, 600vdcw, HP Stock No. 16-11.
R83, 86:	Resistor: fixed, composition, 33,000 ohms, ± 10%, 1W, HP Stock No. 24-33K.
R84, 85:	Resistor: fixed, composition, 68,000 ohms, ± 10%, 1W, HP Stock No. 24-68K.
R87:	Resistor: variable, composition, linear taper, 1500 ohms, ± 10%, 1W, HP Stock No. 210-33.
V17:	Tube, electron: 5687, HP Stock No. 1932-0016.
T2:	Transformer, audio, Stock No. 9120-0022.

Paragraph 4-9, Step g.; and 4-11, step g.
Change to read:
"Using an average responding, electronic a-c voltmeter calibrated in rms volts, such as the HP Model 400D, measure the voltage between FL1 and ground. The voltage at this point is the filament voltage for the r-f oscillator and power amplifier tubes V6 and V8 and is furnished by V17, operating as a multivibrator."

Paragraph 4-11, Step h.
Change to read:
"Adjust R87 for 7.4 volts as read on the 400D scale. FL1 has approximately 0.3 volt IR drop, hence, the voltage on the tubes will read 7.1 volts."

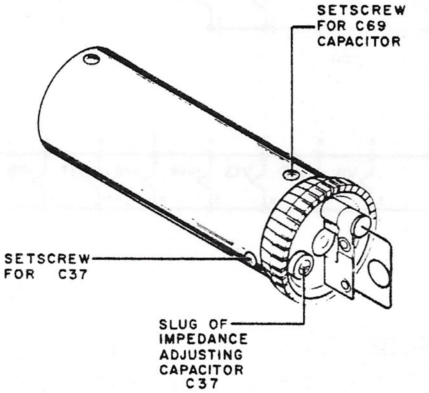
CHANGE F

On Figure 4-17 and Parts List:
Change Q1 to HP Stock No. 1850-0098; Transistor, PNP germanium, Mfr 98925, Mfr Part No. CQT-794 (alternately: Mfr 83298, Mfr Part No. B-1493).

CHANGE G

On Figure 4-7a:

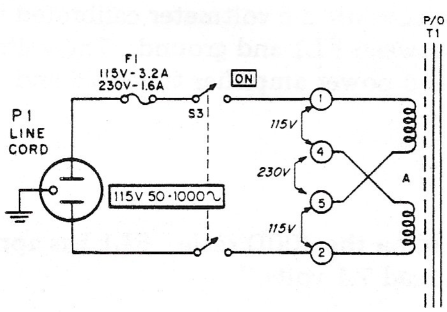
AT1, Stock No. 608D-34. The attenuator probe assembly shown below is identical to the one shown in Figure 4-7a except that a SETSCREW for C37 is located as shown and may be adjusted for minimum VSWR if positioning resistors R59 and R58 does not do the job.



CHANGE H

On Figures 3-12 and 4-17, and Parts List:

Delete S6 and show the primary wiring of T1 as follows:



Change Note 3 to read:

"Power transformer primary shown connected for 115 volt operation. To connect for 230 volt operation disconnect A4 from A1 and A5 from A2. Then connect A4 and A5 together."

CHANGE I

On Figures 1-1 and 2-1:

Change front panel fuse label from "AC LINE" to "AC 3 AMP". The correct fuse for all serial numbers is 3.2 amps for 115 V operation or 1.6 amps for 230V operation.

CHANGE J

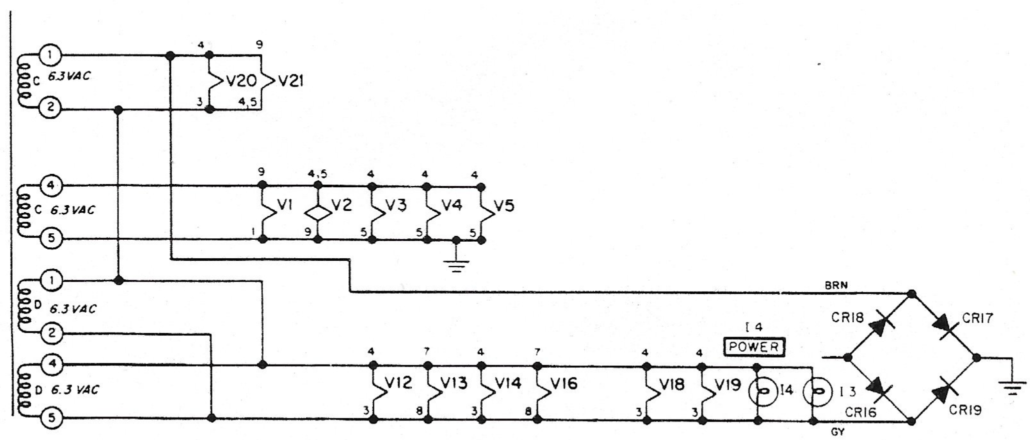
On Figure 4-17 and Parts List:
Add R128 in series with emitter of Q1 with average value of 7 ohm, 3%, 5 W, Stock No. 0812-0033.
Change CR20 to 9V, Stock No. 1920-0037.

CHANGE K

On Figure 4-17 and Parts List:
Delete (short circuit) R129, 1 ohm.

CHANGE L

On Figure 4-17 and Parts List:
Change T1 to Stock No. 9100-0047.
Change Schematic to show the heater wiring as follows:



CHANGE M

On Figures 3-7 and 4-17 and Parts List:
Change R12 to 100 K ohm, Stock No. 0690-1041.
Change V2 to Stock No. 1932-0066.
Change Schematic to show R12 connected from pin 6 to pin 8 of V2A.
On Specifications:
Change frequency drift specification to read:
"Less than 0.005% over a 10 minute interval after initial instrument warm-up (15°C to 35°C ambient). When frequency is changed by dial, instrument must restabilize one minute for each 10% frequency change. When frequency is changed by bandswitching, 10 minutes are required to restabilize."

CHANGE N

On Figure 4-17 and Parts List:
Change F1 to:
2110-0013 3.2 amp slow blow, 115V operation.
2110-0005 1.6 amp slow blow, 230V operation.

CHANGE O

On Figures 3-7 and 4-17 and Parts List:
Change R7 to 2000 ohm, Stock No. 2100-0010.
Change R8 to 1000 ohm, Stock No. 0690-6811.

APPENDIX III SERVICE AND APPLICATION NOTES

TABLE OF CONTENTS

SERVICE NOTE

SUPERSEDES:

None

HP MODEL 608C/D/E/F VHF SIGNAL GENERATORS

608C Serials Below 832-07540
608D Serials Below 828-12556
608E Serials Below 833-01821
608F Serials Below 832-01151

RECOMMENDED REPLACEMENT FOR R7 AND R8

Greater resolution and stability can be attained in the Modulation Oscillator Amplitude Adjustment of HP Model 608C/D/E/F Signal Generators, serials listed above, by changing the values of R7 and R8.

Change the Modulation Oscillator adjustment, R7, to a 1000 Ω variable resistor, HP Part Number 2100-0036.

Change the fixed resistor R8 to a 1200 Ω resistor, HP Part Number 0690-1221.

After changing these resistors perform the adjustments given in the Section entitled REPLACEMENT OF LAMP L1 in your Operating and Service Manual. Also, show these changes in the Parts List and schematics.

JD/mh/wo

4/69-4

Customer Service • 333 Logue Avenue, Mountain View, California 94040. Tel. (415) 968-9200
Europe: 54 Route Des Acacias, Geneva, Switzerland, Cable: "HEWPACKSA" Tel. (022) 42.81.50

SERVICE NOTE

SUPERSEDES:
None

HP MODEL 608C/D/E/F VHF SIGNAL GENERATORS

608C Serials Below 832-07415
608D Serials Below 828-12506
608E Serials Below 826-01321
608F Serials Below 832-01001

RECOMMENDED REPLACEMENT FOR F1 FUSE

The recommended replacement for the power line fuse F1 in HP Model 608C/D/E/F Signal Generators, serials listed above, has a slightly higher current rating.

For 115 V Operation:

4.0 Amp Slow-Blow HP Part Number 2110-0014

For 230 V Operation:

2.0 Amp Slow-Blow HP Part Number 2110-0006

The current ratings for the F1 fuse have been increased to the above values to prevent the fuse from blowing unnecessarily during current surges.

Note this change in your Operating and Service Manual.

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HEWLETT hp PACKARD

ILLUSTRATED PARTS IDENTIFICATION

MODEL 608C / D

SIGNAL GENERATOR

PRINTED: MAY 1964

Customer Service • 395 Page Mill Road, Palo Alto, California 94306. Tel. (415) 326-3950
Europe: 54 Route Des Acacias, Geneva, Switzerland, Cable: "HEWPACKSA" Tel. (022) 42.81.50

Printed in U.S.A.

Ref.	hp Stock No.	Description	Qty.
1		See Figure 2	
2		See Figure 6, 8, 9, 10 & 11	
3		See Figure 7	
4		See Figure 5	
5		See Figure 3	
6		See Figure 4	
7	608D-5A	Angle Bracket: Upper Right	1
8	698D-5B	Angle Bracket: Upper Left	1
9	608D-20G	Hub: Dial Drum	1
10	608D-20C	Drum: Frequency Dial	1
11	608A-40A	Dial: Frequency Blank	1
12	608A-40B	Lock: Frequency Dial	1
13	1480-0004	Pin: Roll 0.094 OD 0.375 LG	1
14	2920-0004	Screw: RH SS 10-24 X 3/4	3
15	608D-44	Cabinet Assy.	1

Ref.	hp Stock No.	Description	Qty.
16	608D-44K	Screw: Machine Captive	4
17	2920-0002	Screw: Machine RH SS 10-24 X 1/2	5
18	2930-0001	Screw: Machine FH SS 10-24 X 5/8	2
19	2520-0003	Screw: Machine RH SS 8-32 X 1/2	5
20	2520-0002	Screw: Machine RH SS 8-32 X 3/8	4
21	2550-0009	Screw: Machine BH SS 8-32 X 1/2	2
22	3050-0032	Washer: Brass 5/16 OD 0.190 ID	5
23	2520-0003	Screw: Machine RH SS 8-32 X 1/2	4
24	608A-27D	Filter: Electrical DC	3
25	608A-27A	Filter: Electrical RF	2
26	608A-27C	Filter: Electrical Modulator	1
27	2190-0009	Washer: Lock INT NO. 8	3

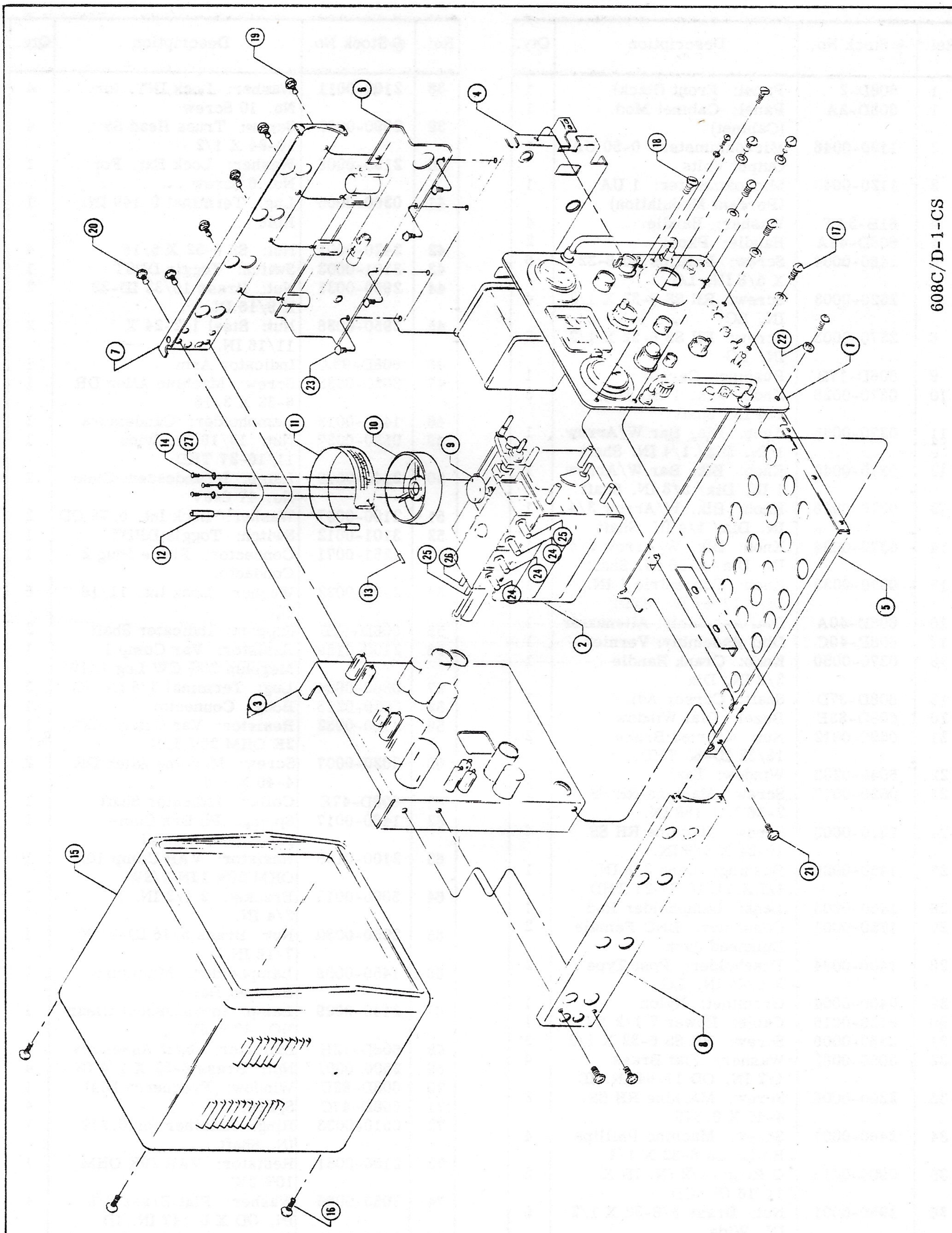


Figure 1. ⓗⓟ Model 608C/D Signal Generator, General Arrangement

Ref.	hp Stock No.	Description	Qty.
1	608D-2	Panel: Front (Rack)	1
1	608D-2A	Panel: Cabinet Mod. (Cabinet)	1
2	1120-0046	Microammeter: 0-50 UA Output Volts	1
3	1120-0040	Microammeter: 1 UA (Percent Modulation)	1
4	61B-3AT	Washer: Handle	4
5	608D-48A	Handle: Panel	2
6	2460-0004	Screw: Phillips Hd 6-32 X 5/8 IN. LG	6
7	2520-0003	Screw: RH SS 8-32 X 1/2 IN. LG	4
8	2370-0003	Screw: FH SS 6-32 X 1/2 IN. LG	5
9	608D-17B	Bushing: Cursor	1
10	0370-0028	Knob: Blk. 1 IN. Dia/ 1/4 IN. Shaft	3
11	0370-0035	Knob: Blk. Bar W/Arrow 1 IN. Dia/ 1/4 IN. Shaft	1
12	0370-0049	Knob: Blk. Bar W/Arrow 1 IN. Dia/ 3/8 IN. Shaft	1
13	0370-0026	Knob: Blk. W/Arrow 3/4 IN. Dia/ 1/4 IN. Shaft	1
14	0370-0024	Knob: Blk. W/Arrow 3/4 IN. Dia/ 3/16 IN. Shaft	1
15	0370-0033	Knob: Concentric 1 IN. Dia/ 17/64 IN. Shaft	1
16	608D-40A	Dial Assembly: Attenuator	1
17	608D-40C	Dial Assembly: Vernier	1
18	0370-0050	Knob: Crank Handle 3/8 IN. Dia	1
19	608D-37D	Shaft: Cursor Adj.	1
20	608D-83E	Bezel: Dial Window	1
21	0590-0012	Nut: Knurled Brass 13/32 ID-32 THD.	2
22	5040-0232	Window: Dial	1
23	0520-0017	Screw: Machine RH SS 2-56 X 0.188 IN.	2
24	2920-0003	Screw: Machine RH SS 10-24 X 5/8 IN.	4
25	1450-0026	Bushing: Lens 3/8 IN. LG X 11/16 ID-27 THD	1
26	1450-0003	Lens: Lampholder Red	1
27	1250-0001	Connector: BNC Female Bulkhead Jack	2
28	1400-0084	Fuseholder: Post Type 2-5/64 IN. LG	2
29	0400-0004	Grommet: Nylon	1
30	8120-0015	Cable: Power 7 1/2 FT.	1
31	2360-0006	Screw: RH SS 6-32 X 1/2	3
32	3050-0063	Washer: Flat Brass 1/2 IN. OD 11/64 IN. ID	4
33	2200-0006	Screw: Machine RH SS 4-40 X 0.375	8
34	2460-0001	Screw: Machine Phillips Hd Brass 6-32 X 1/4	4
35	0900-0016	O Ring: 1/2 IN. ID X 11/16 IN. OD	2
36	2950-0001	Nut: Brass 3/8-32 X 1/2 IN. Wide	6
37	3050-0067	Washer: Flat Brass 5/8 IN. OD X 3/8 IN. ID	1

Ref.	hp Stock No.	Description	Qty.
38	2190-0011	Washer: Lock INT. for No. 10 Screw	4
39	2990-0002	Screw: Truss Head SS 10-24 X 1/2	4
40	2190-0008	Washer: Lock Ext. For No. 6 Screw	1
41	0360-0005	Lug: Terminal 0.149 IN. Hole	1
42	2420-0001	Nut: SS 6-32 X 5/16	4
43	3101-0003	Switch: Toggle DPST	1
44	2950-0035	Nut: Brass 15/32 ID-32 X 9/16 IN.	2
45	2950-0038	Nut: Steel 1/2-24 X 11/16 IN.	2
46	608D-99A	Indicator Arm	1
47	3030-0033	Screw: Machine Allen DR 6-32 X 3/16	1
48	1450-0013	Lampholder: Candelabra	1
49	0590-0037	Nut: 13/16 IN. Wide 11/16-27 THD	1
50	2140-0009	Lamp: Incandescent Clear No. 47 6-8V	1
51	2190-0037	Washer: Lock Int. 0.78 OD	2
52	3101-0012	Switch: Toggle DPDT	1
53	1251-0071	Connector: Phone Plug 2 Conductor	1
54	2190-0022	Washer: Lock Int. 11/16 OD	6
55	608D-12E	Support: Indicator Shaft	2
56	2100-0159	Resistor: Var Comp 1 Megohm 20% CW Log 1/4W	1
57	0360-0024	Lug: Terminal 3/8 IN. ID	3
58	5020-0215	Body: Connector	1
59	2100-0052	Resistor: Var Comp 50K-2K OHM 20% LIN	1
60	3030-0007	Screw: Machine Allen DR 4-40 X 1/8	2
61	608D-47E	Collar: Indicator Shaft	1
62	1460-0017	Spring: Ph Brz Compression 4 IN. LG	1
63	2100-0156	Resistor: VAR Comp 10K OHM 20% LIN 1/2W	1
64	5000-0013	Bracket: 2 1/2 IN. X 3/4 IN.	1
65	2950-0030	Nut: Brass 5/16 ID-24 X 7/16 IN.	1
66	1450-0009	Lampholder: Miniature Bayonet Base	1
67	2140-0009	Lamp: Incandescent Clear NO. 47 6-8V	1
68	608D-12H	Indicator: Shaft Assembly	1
69	2500-0001	Nut: Brass 6-32 X 1/4 IN.	4
70	608D-83C	Window: Frequency Dial	1
71	608D-47C	Spacer	4
72	0510-0033	Ring: Retainer for 0.219 IN. Shaft	1
73	2100-0051	Resistor: VAR 20K OHM 10% 2W	1
74	3050-0066	Washer: Flat Brass 3/8 IN. OD X 0.147 IN. ID	4
75	2190-0007	Washer: Lock Int. For NO. 6 Screw	4

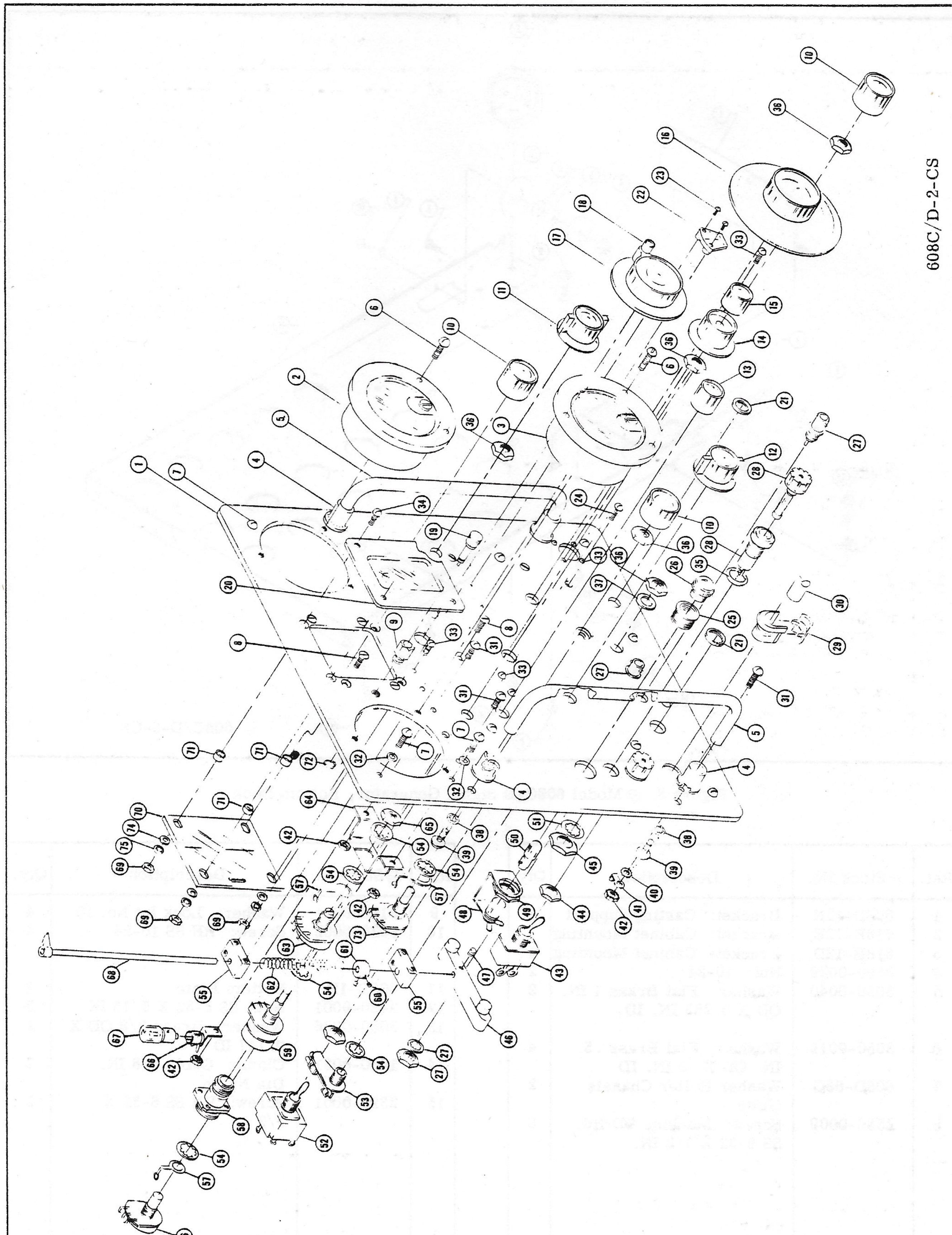


Figure 2. hp Model 608C/D Signal Generator, Front Panel Assembly

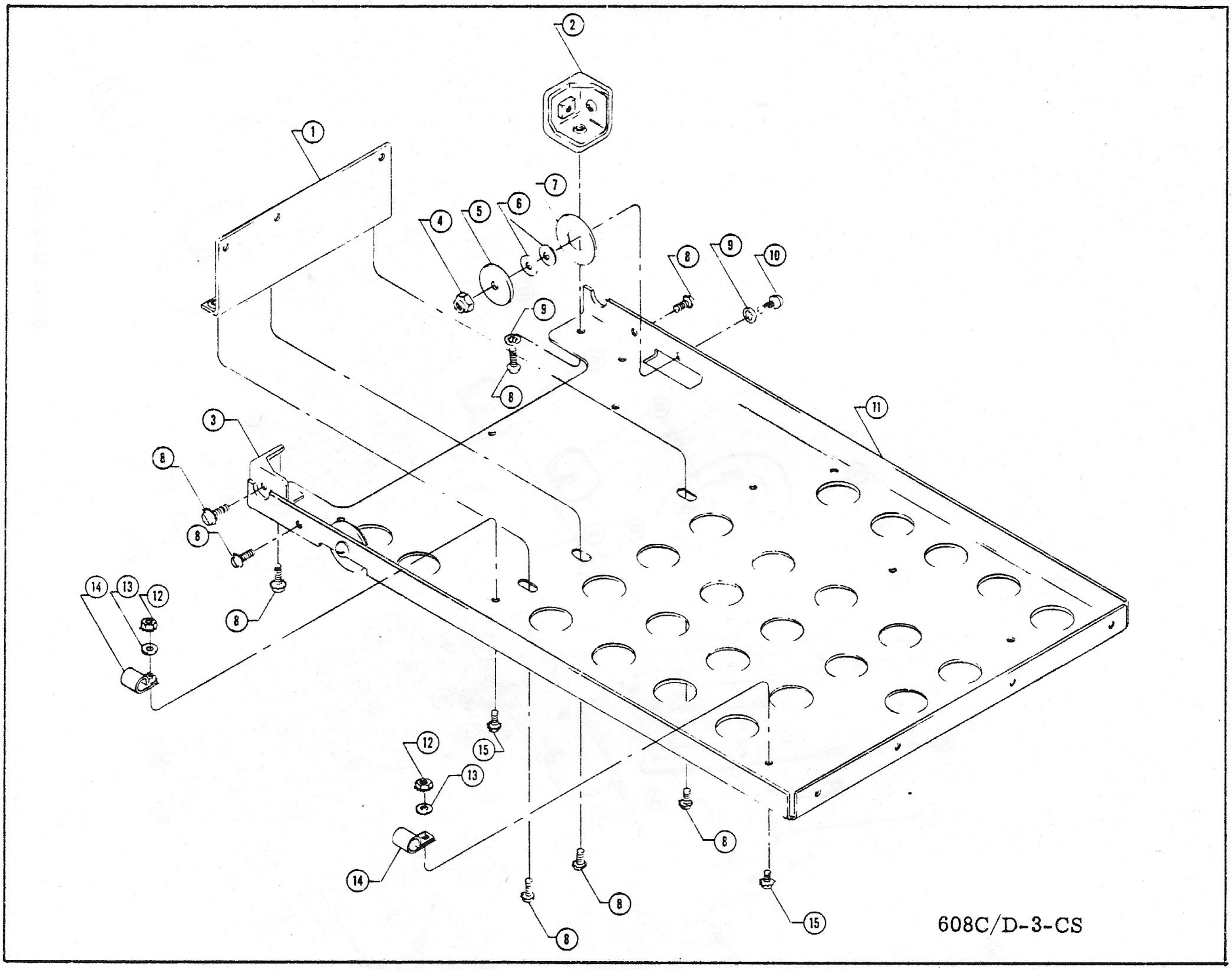


Figure 3. ⓗⓟ Model 608C/D Signal Generator, Bottom Deck

Ref.	ⓗⓟ Stock No.	Description	Qty.
1	608D-12N	Bracket: Casting Support	1
2	618B-12E	Bracket: Cabinet Mounting	1
3	618B-12D	Bracket: Cabinet Mounting	1
4	0590-0029	Nut: 10-24	2
5	3050-0040	Washer: Flat Brass 1 IN. OD X 0.253 IN. ID	2
6	3050-0019	Washer: Flat Brass .5 IN. OD X .2 IN. ID	4
7	608D-88G	Washer Roller Chassis Glide	2
8	2550-0009	Screw: Machine BD Hd SS 8-32 X 1/2 IN.	8
9	2190-0011	Washer: Lock Int No. 10	4
10	2920-0002	Screw: RH SS 10-24	4
11	608D-1B	Bottom Plate	1
12	2420-0001	Nut: SS 6-32 X 5/16 IN.	2
13	3050-0066	Washer: Brass 3/8 OD X 0.147 ID	2
14	1400-0031	Clamp: Cable 3/8 IN. Dia Nylon	2
15	2390-0001	Screw: BH SS 6-32 X 1/2	2

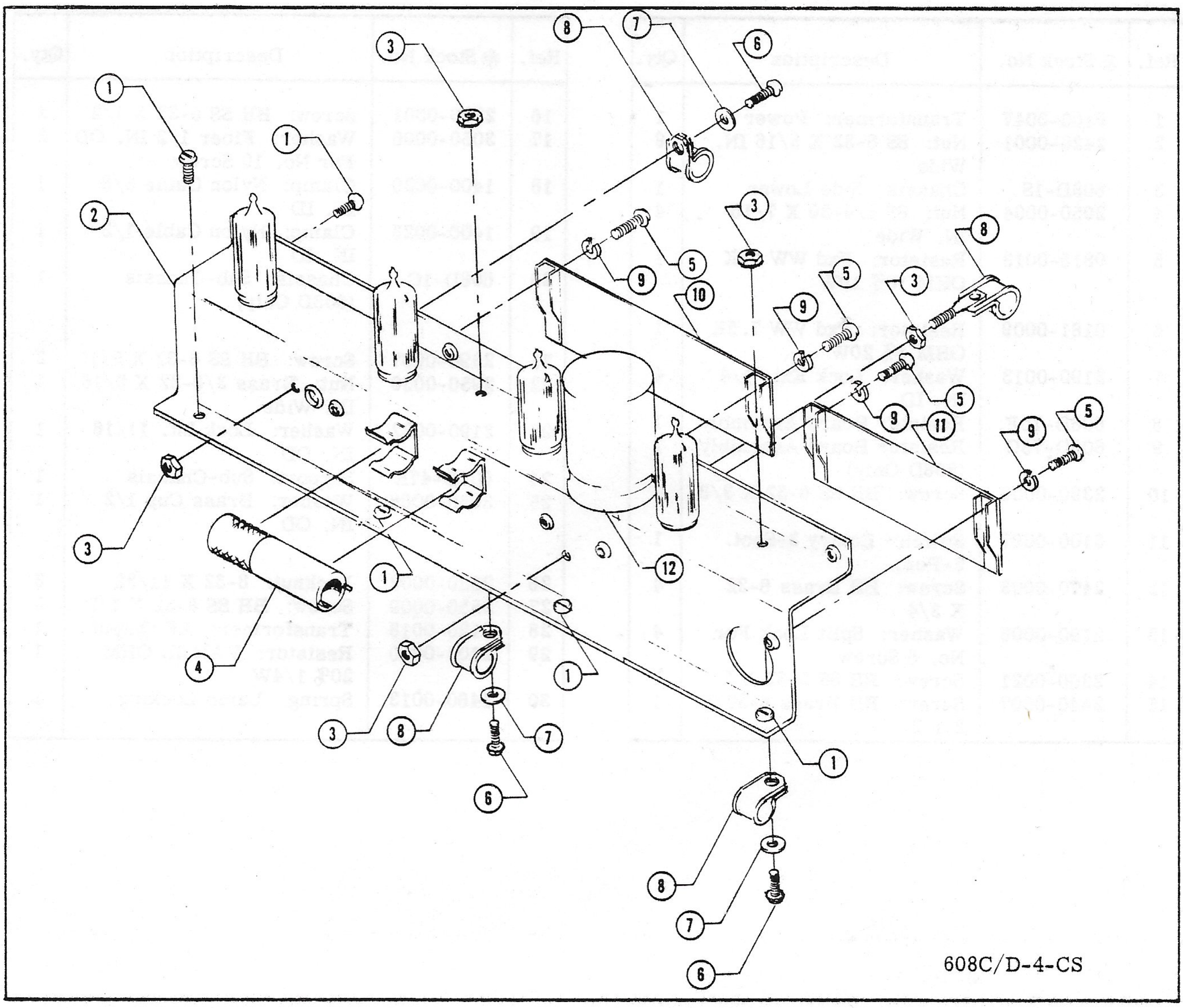


Figure 4. ⓗⓟ Model 608C/D Signal Generator, Right Middle Deck

Ref.	ⓗⓟ Stock No.	Description	Qty.
1	2550-0009	Screw: BH SS 8-32 X 3/8	8
2	608D-1U	Chassis: Side Upper	1
3	2420-0001	Nut: SS 6-32 X 5/16	5
4	612A-38A	Wrench: Tube	1
5	2470-0003	Screw: BH Brass 6-32 X 3/4	4
6	2390-0001	Screw: BH SS 6-32 X 1/2	3
7	3050-0066	Washer: Flat Steel 3/8 IN. OD X 0.203 IN. ID	3

Ref.	ⓗⓟ Stock No.	Description	Qty.
8	1400-0025	Clamp: Cable Nylon 1/2 IN. Dia	4
9	2190-0006	Washer: Split Lock for No. 6 Screw	4
10	608D-75E	Resistor Board Assembly: (608D Only)	1
11	608D-75D	Resistor Board Assembly	1
12	0180-0018	Capacitor: Fxd Elect 2 X 10 UF -10% + 50% 450VDCW	1

Ref.	ⓗⓟ Stock No.	Description	Qty.
1	9100-0047	Transformer: Power	1
2	2420-0001	Nut: SS 6-32 X 5/16 IN. Wide	9
3	608D-1S	Chassis: Side Lower	1
4	2950-0004	Nut: SS 1/4-20 X 7/16 IN. Wide	4
5	0816-0013	Resistor: Fxd WW 15K OHM 10% 10W	1
6	0181-0009	Resistor: Fxd WW 7.5K OHM 5% 20W	1
7	2190-0013	Washer: Lock Ext. 1/4 IN. ID	4
8	608D-75F	Resistor Board Assembly	1
9	608D-75G	Resistor Board Assembly: (608D Only)	1
10	2390-0009	Screw: BH SS 6-32 X 3/8	1
11	3100-0097	Switch: Rotary 3-Sect. 5-Pos.	1
12	2470-0003	Screw: BH Brass 6-32 X 3/4	4
13	2190-0006	Washer: Split Lock For No. 6 Screw	4
14	2360-0021	Screw: RH SS 6-32 X 2	1
15	2440-0007	Screw: RH Brass 6-32 X 2 1/2	1

Ref.	ⓗⓟ Stock No.	Description	Qty.
16	2390-0001	Screw: BH SS 6-32 X 1/2	2
17	3050-0006	Washer: Fiber 1/2 IN. OD For No. 10 Screw	2
18	1400-0020	Clamp: Nylon Cable 5/8 IN. ID	1
19	1400-0025	Clamp: Nylon Cable 1/2 IN. ID	1
20	608D-1C	Chassis: Sub-Chassis (608D Only)	1
21	2390-0007	Screw: BH SS 6-32 X 5/16	2
22	2950-0030	Nut: Brass 3/8-32 X 9/16 IN. Wide	1
23	2190-0022	Washer: Lock Int. 11/16 IN. OD	1
24	608D-47K	Support: Sub-Chassis	1
25	3050-0088	Washer: Brass Cup 1/2 IN. OD	1
26	2580-0003	Locknut: 8-32 X 11/32	3
27	2550-0009	Screw: BH SS 8-32 X 1/2	3
28	9120-0018	Transformer: AF Output	1
29	2100-0010	Resistor: VAR 2K OHM 20% 1/4W	1
30	1460-0013	Spring: Lamp Locking	1

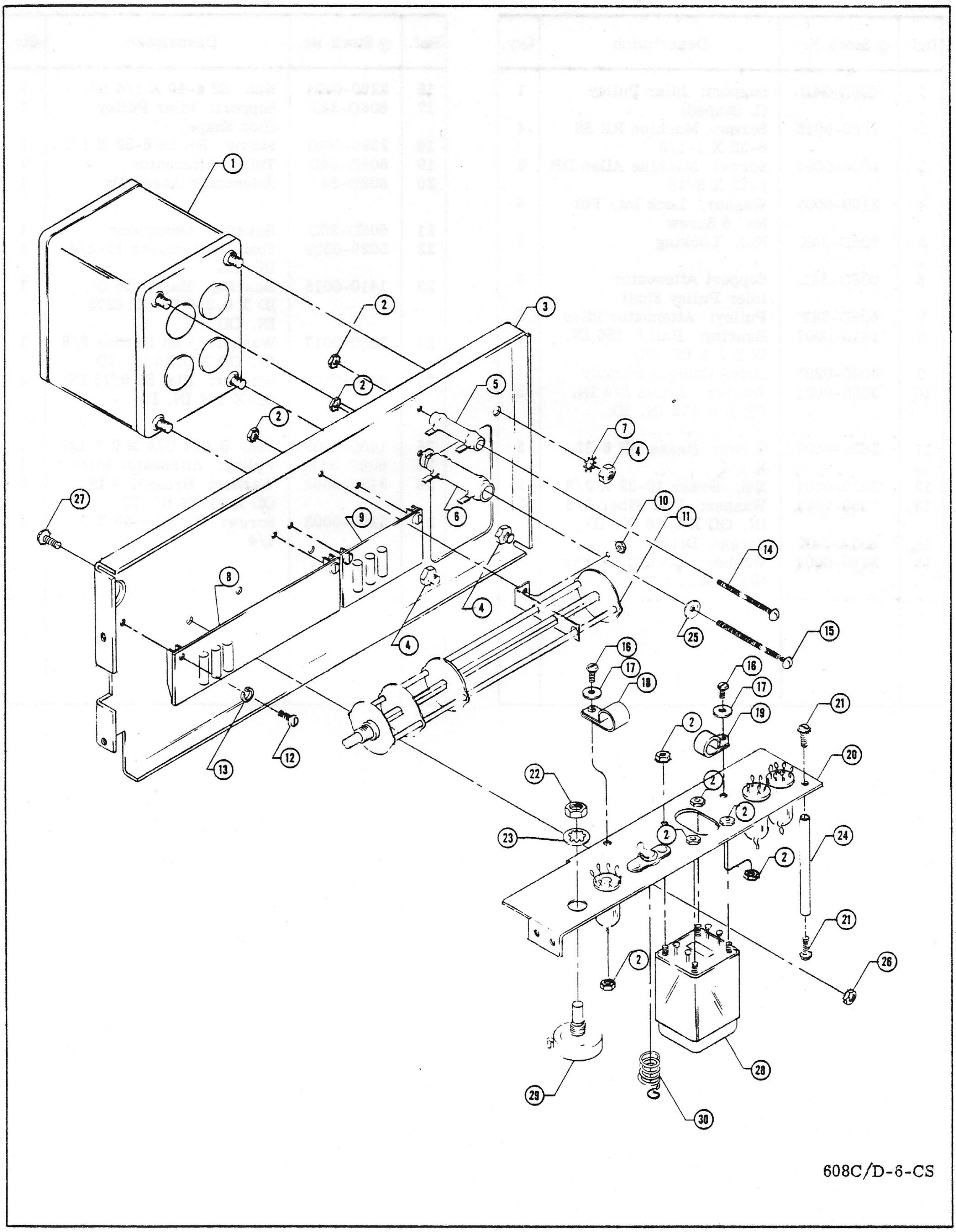


Figure 5. ⓗⓟ Model 608C/D Signal Generator, Right Lower Deck

Ref.	Stock No.	Description	Qty.
1	608D-34H	Support: Idler Pulley (L Shaped)	1
2	2360-0015	Screw: Machine RH SS 6-32 X 1-1/8	4
3	3030-0001	Screw: Machine Allen DR 8-32 X 3/16	3
4	2190-0007	Washer: Lock Int. For No. 6 Screw	4
5	608D-34K	Nut: Locking	1
6	608D-34L	Support Attenuator Idler Pulley Shaft	1
7	608D-34F	Pulley: Attenuator Idler	3
8	1410-0007	Bearing: Ball 0.156 IN. W X 0.5 IN. OD	3
9	5060-0205	Drive Cable Assembly	1
10	3050-0001	Washer: Brass 3/8 IN. OD X 0.172 IN. ID	3
11	2630-0007	Screw: Brass BH 8-32 X 1/4	3
12	2820-0001	Nut: Brass 10-32 X 3/8	2
13	3050-0021	Washer: Flat Fiber 3/8 IN. OD X 3/16 IN. ID	2
14	608A-34K	Screw: Drive	1
15	2190-0004	Washer: Lock INT. For NO. 4 Screw	1

Ref.	Stock No.	Description	Qty.
16	2260-0001	Nut: SS 4-40 X 1/4 IN.	1
17	608D-34J	Support: Idler Pulley (Box Shape)	1
18	2390-0001	Screw: BH SS 6-32 X 1/2	1
19	608D-34D	Tube: Attenuator	1
20	608D-34	Attenuator Assembly	1
21	608D-20D	Housing: Generator	1
22	5029-0359	Shaft: Attenuator 11-3/4 IN. LG	1
23	1410-0015	Bearing: Ball 0.25 IN. ID X 0.250 IN./0.6275 IN. OD	1
24	3050-0017	Washer: Flat Bronze 3/8 IN. OD X 0.26 IN. ID	1
25	3050-0103	Washer: Flat SS 9/16 IN. OD X 1/4 IN. ID	2
26	1480-0009	Pin: 0.094 DIA X 0.5 LG	1
27	608D-34F	Pulley: Attenuator Idler	1
28	3150-0063	Washer: Brass 1/4 IN. OD X 11/64 IN. ID	2
29	2200-0003	Screw: RH SS 4-40 X 1/4	2

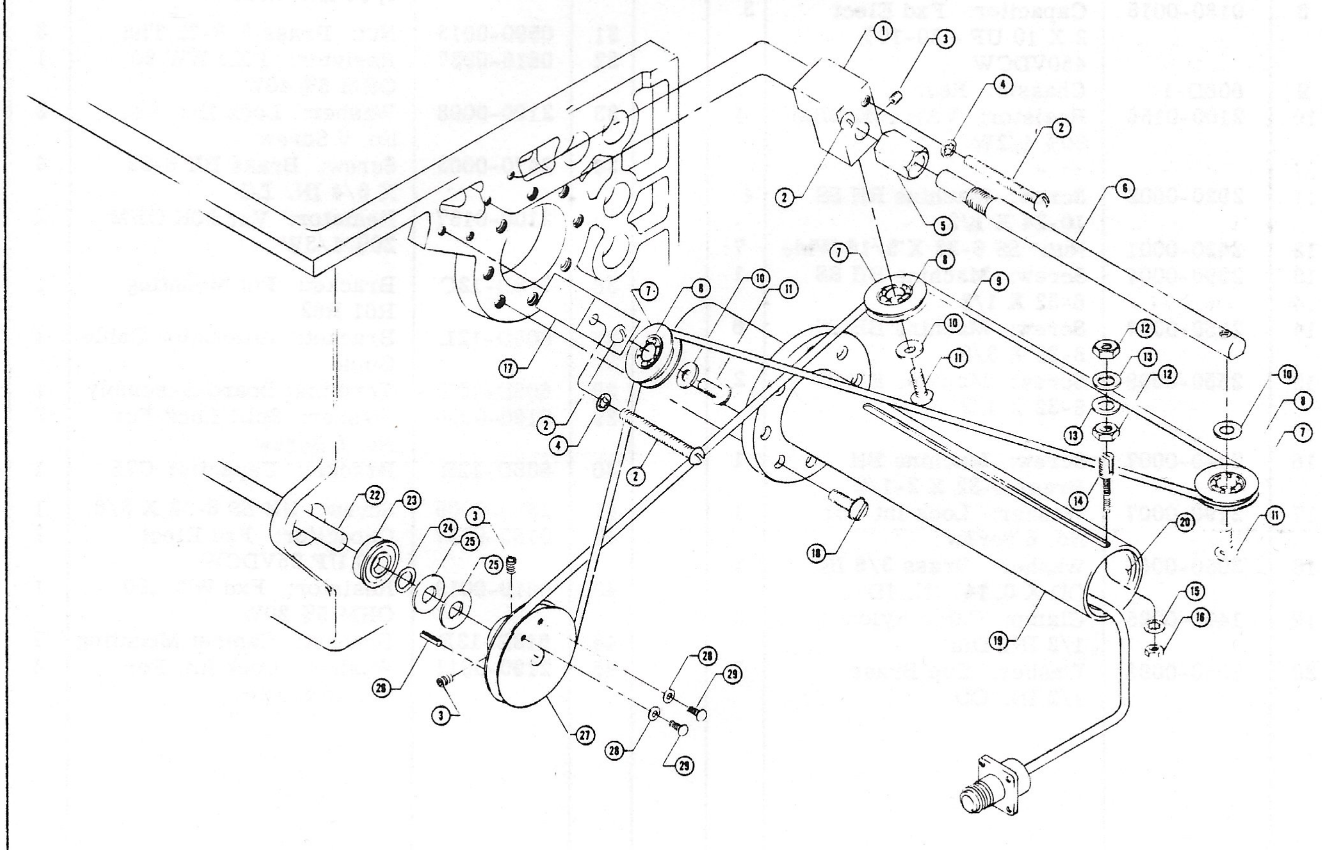


Figure 6. hp Model 608C/D Signal Generator, Attenuator Housing and Drive Mechanism

Ref.	Ⓗ Stock No.	Description	Qty.
1	2290-0009	Screw: RH SS 4-40 X 1/2	2
2	2190-0004	Washer: Lock INT. For NO. 4 Screw	2
3	1850-0087	Transistor: Germanium PNP 2N1544	1
4	1200-0043	Insulator: Transistor	1
5	2390-0007	Screw: Machine BH SS 6-32 X 5/16	10
6	0180-0020	Capacitor: Fxd Elect 80 UF + 100-20% 450VDCW	2
7	0180-0019	Capacitor: Fxd Elect 45 UF + 50-10% 450VDCW	1
8	0180-0018	Capacitor: Fxd Elect 2 X 10 UF + 50-10% 450VDCW	3
9	608D-1	Chassis: Rear	1
10	2100-0156	Resistor: VAR 10K OHM 20% 1/2W	1
11	2920-0002	Screw: Machine RH SS 10-24 X 1/2	4
12	2420-0001	Nut: SS 6-32 X 5/16 Wide	7
13	2390-0001	Screw: Machine BH SS 6-32 X 1/2	1
14	2550-0007	Screw: Machine BH SS 8-32 X 3/8	6
15	2550-0009	Screw: Machine BH SS 8-32 X 1/2	2
16	2440-0007	Screw: Machine BH Brass 6-32 X 2-1/2	1
17	2190-0007	Washer: Lock Int For No. 6 Screw	1
18	3050-0066	Washer: Brass 3/8 IN. OD X 0.147 IN. ID	1
19	1400-0025	Clamp: Cable Nylon 1/2 IN. Dia	3
20	3050-0088	Washer: Cup Brass 1/2 IN. OD	2

Ref.	Ⓗ Stock No.	Description	Qty.
21	618B-12D	Bracket: Cabinet Mounting	1
22	608D-75H	Board Assy: Terminal	1
23	608D-75B	Resistor Board Assy.	1
24	608D-75A	Resistor Board Assy.	1
25	1200-0081	Bushing: Nylon	2
26	2190-0003	Washer: Split Lock For No. 4 Screw	2
27	0360-0056	Lug: Terminal For 1/4 IN. Screw	1
28	2260-0001	Nut: SS 4-40 X 1/4 IN.	2
29	2190-0022	Washer: Lock Int. 3/8 ID	5
30	2950-0030	Nut: Brass 3/8-32 X 9/16 IN. Wide	3
31	0590-0013	Nut: Brass 3/8-32 Thd	3
32	0818-0027	Resistor: FXD WW 60 OHM 5% 40W	1
33	2190-0008	Washer: Lock Ext. For No. 6 Screw	2
34	2470-0003	Screw: Brass BH 6-32 X 3/4 IN. LG	4
35	2100-0157	Resistor: Var 50K OHM 20% 1/3W	2
36	618B-12C	Bracket: Pot Mounting R61 R62	1
37	608D-12L	Bracket: Attenuator Cable Guide	1
38	608D-75T	Terminal Board Assembly	1
39	2190-0006	Washer: Split Lock For No. 6 Screw	2
40	608D-12R	Bracket: Capacitor C75	1
41	2390-0009	Screw: BH SS 6-32 X 3/8	1
42	0180-0057	Capacitor: Fxd Elect 100 UF 25VDCW	1
43	0819-0019	Resistor: Fxd WW 100 OHM 5% 20W	1
44	618B-12E	Bracket: Cabinet Mounting	1
45	2190-0011	Washer: Lock Int. For No. 10 Screw	4

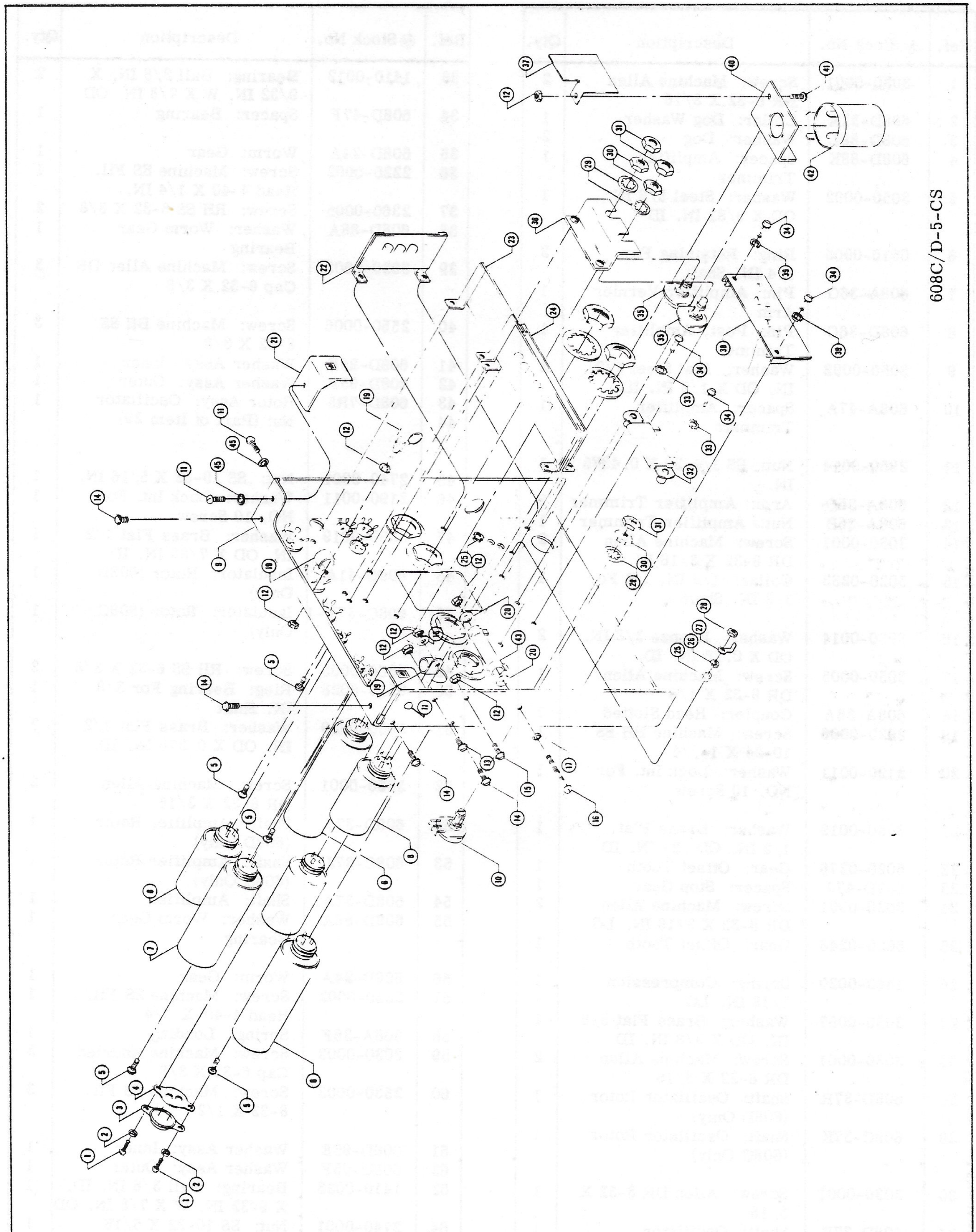


Figure 7. ⓗⓟ Model 608C/D Signal Generator Rear Deck Assembly

Ref.	Stock No.	Description	Qty.
1	3030-0001	Screw: Machine Allen DR 8-32 X 3/16	2
2	608D-32A	Collar: Dog Washer	1
3	608D-88L	Washer: Dog	2
4	608D-88K	Spacer: Amplifier Trimmer	1
5	3050-0092	Washer: Steel 5/8 IN. OD X 9/32 IN. ID	1
6	0510-0005	Ring: Retaining For 1/4 IN. Shaft	2
7	608A-36G	Pin: Amplifier Vernier Arm	1
8	608D-36C	Pin: Post, Amplifier Trimmer	1
9	3050-0092	Washer: Flat Steel 5/8 IN. OD X 1/8 IN. ID	2
10	608A-47A	Spacer: Amplifier Trimmer	1
11	2950-0014	Nut: SS 1/4-28 X 0.4375 IN.	1
12	608A-36D	Arm: Amplifier Trimmer	2
13	608A-36B	Nut: Amplifier Trimmer	1
14	3030-0001	Screw: Machine Allen DR 8-32 X 3/16 IN.	2
15	5020-0233	Collar: 1/4 IN. LG For 1/2 IN. Shaft	1
16	3050-0014	Washer: Bronze 3/8 IN. OD X 0.26 IN. ID	2
17	3030-0005	Screw: Machine Allen DR 8-32 X 1/8	1
18	608A-36A	Coupler: Head Slotted	1
19	2920-0006	Screw: Machine RH SS 10-24 X 1-3/4	1
20	2190-0011	Washer: Lock Int. For NO. 10 Screw	1
21	3050-0019	Washer: Brass Flat 1/2 IN. OD .21 IN. ID	1
22	5020-0276	Gear: Offset Tooth	1
23	608D-47J	Spacer: Stop Gear	1
24	3030-0001	Screw: Machine Allen DR 8-32 X 3/16 IN. LG	2
25	5020-0248	Gear: Offset Tooth	1
26	1460-0020	Spring: Compression 7/16 IN. LG	1
27	3050-0067	Washer: Brass Flat 5/8 IN. OD X 3/8 IN. ID	1
28	3030-0001	Screw: Machine Allen DR 8-32 X 3/16	2
29	608D-37R	Shaft: Oscillator Rotor (608D Only)	1
29	608C-37K	Shaft: Oscillator Rotor (608C Only)	1
30	3030-0001	Screw: Allen DR 8-32 X 3/16	1
31	608D-37B	Shaft: Oscillator	1
32	0510-0028	Ring: Bearing For 3/8 IN. Shaft	2

Ref.	Stock No.	Description	Qty.
33	1410-0012	Bearing: Ball 3/8 IN. X 9/32 IN. W X 7/8 IN. OD	2
34	608D-47F	Spacer: Bearing	1
35	608D-24A	Worm: Gear	1
36	2220-0002	Screw: Machine SS Fil. Head 4-40 X 1/4 IN.	1
37	2360-0005	Screw: RH SS 6-32 X 3/8	2
38	608D-88A	Washer: Worm Gear Bearing	1
39	3030-0003	Screw: Machine Allen DR Cap 6-32 X 3/8	3
40	2550-0006	Screw: Machine BH SS 8-32 X 3/8	3
41	608D-95E	Washer Assy: Inner	1
42	608D-95F	Washer Assy: Outer	1
43	608D-7R5	Rotor Assy: Oscillator	1
44		Nut (Part of Item 29)	
45	2740-0001	Nut: SS 10-32 X 5/16 IN.	1
46	2190-0011	Washer: Lock Int. For NO. 10 Screw	1
47	3050-0019	Washer: Brass Flat 1/2 IN. OD X 7/32 IN. ID	1
48	608D-41A	Insulator: Rotor (608D Only)	1
48	608C-37H-1	Insulator: Rotor (608C Only)	1
49	2360-0005	Screw: RH SS 6-32 X 3/8	2
50	0510-0028	Ring: Bearing For 3/8 IN. Shaft	1
51	3050-0029	Washer: Brass Flat 1/2 IN. OD X 0.378 IN. ID	2
52	3030-0001	Screw: Machine Allen DR 8-32 X 3/16	2
53	608D-37J	Shaft: Amplifier Rotor (608D Only)	1
53	608C-37J	Shaft: Amplifier Rotor (608C Only)	1
54	608D-37A	Shaft: Amplifier	1
55	608D-88A	Washer: Worm Gear Bearing	1
56	608D-24A	Worm: Gear	1
57	2220-0002	Screw: Machine SS Fil. Head 4-40 X 1/4	1
58	608A-36F	Spring: Loading	1
59	3030-0003	Screw: Machine Knurled Cap 6-32 X 3/8	3
60	2530-0003	Screw: Machine SS FH 8-32 X 1/2	3
61	608D-95E	Washer Assy: Inner	1
62	608D-95F	Washer Assy: Outer	1
63	1410-0023	Bearing: Ball 3/8 IN. ID X 9/32 IN. W X 7/8 IN. OD	1
64	2740-0001	Nut: SS 10-32 X 5/16	1

Ref.	hp Stock No.	Description	Qty.
65	2190-0011	Washer: Lock Int. For No. 10 Screw	1
66	3050-0019	Washer: Brass 1/2 IN. OD X 7/32 IN. ID	1
67	608D-41A	Insulator: Rotor (608D Only)	1
67	608C-37H-1	Insulator: Rotor (608C Only)	1
68	608D-7R6	Rotor Assy: Amplifier	1
69	3050-0090	Washer: Spring 7/8 IN. OD X 5/8 IN. ID	1
70	1410-0012	Bearing: Ball 3/8 IN. ID X 3/32 IN. W X 7/8 IN. OD	3
71	1480-0008	Pin: 1/16 IN. DIA. 1/2 IN. LG	2
72	608D-20H	Chassis	1
73	1410-0015	Bearing: Ball 1/4 IN. ID X 1/4 IN. W X 5/8 IN. OD	1
74	608D-37N	Shaft: Amplifier Trimmer	1
75	3050-0029	Washer: Brass Flat 1/2 IN. OD X 0.378 IN.	1

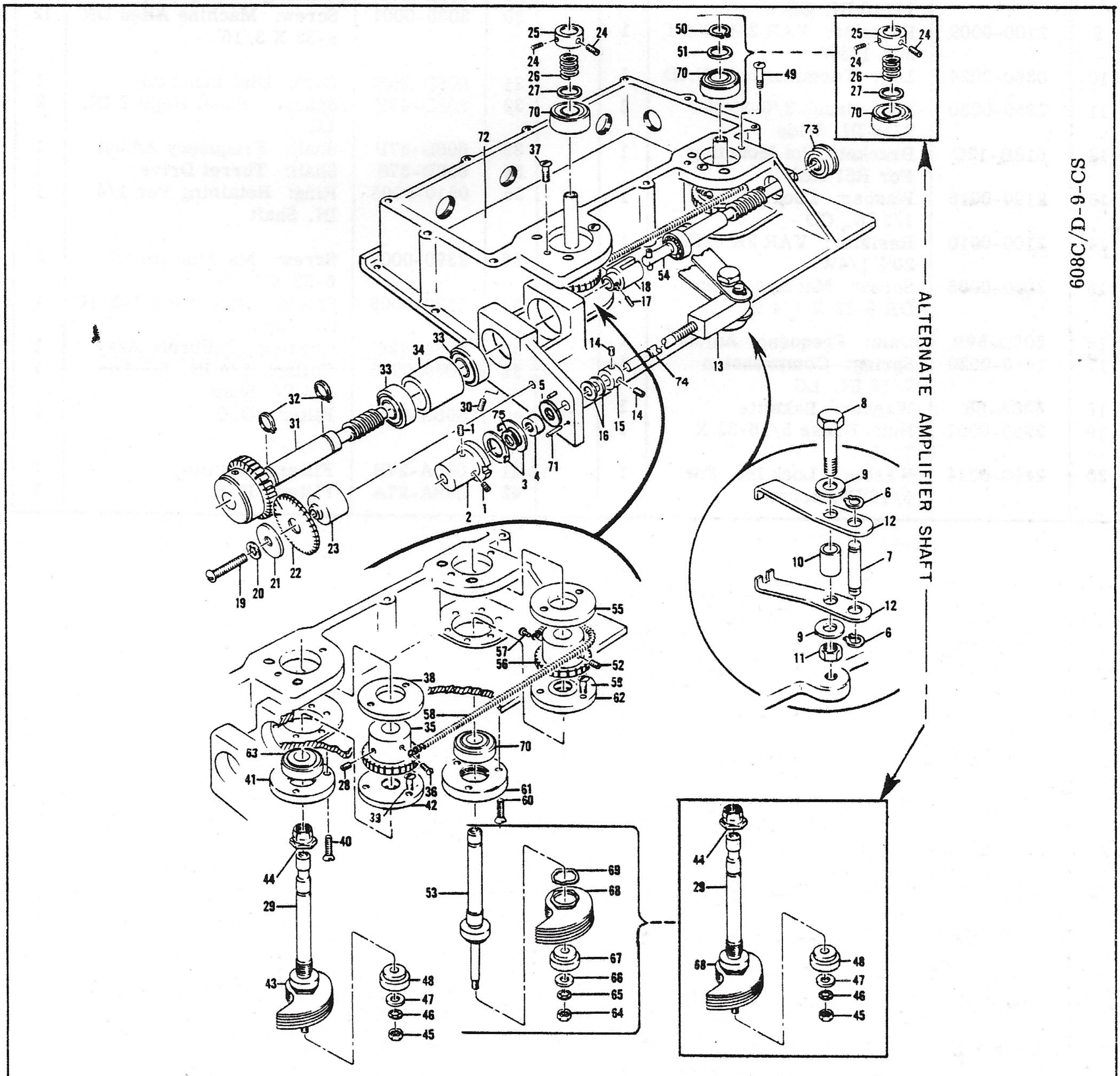
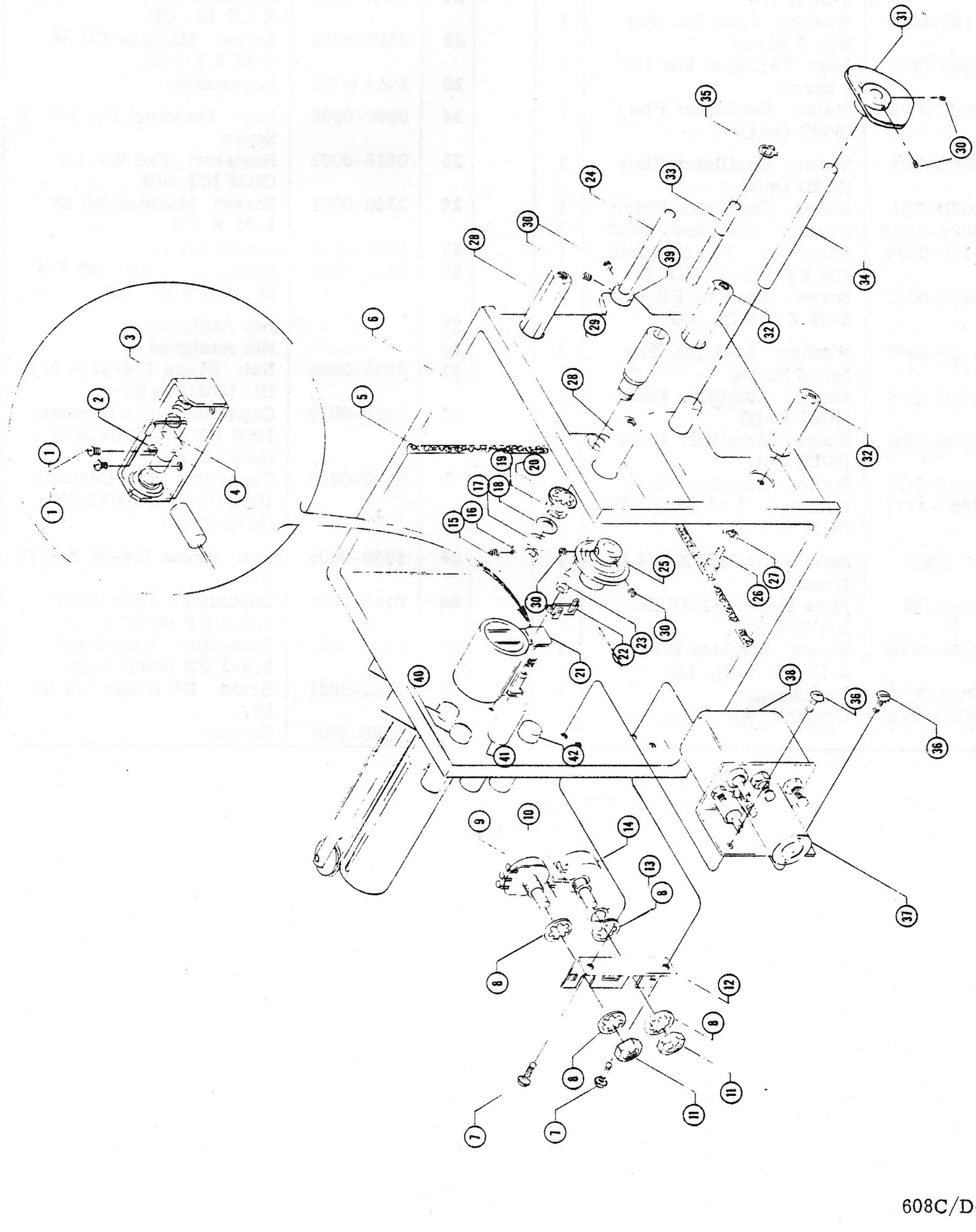


Figure 8. hp Model 608C/D Signal Generator, Frequency Drive Mechanism

Ref.	Stock No.	Description	Qty.
1	0520-0017	Screw: Machine RH SS 2-56 X 3/16	2
2	0520-0021	Screw: Machine Nylon Fil. Head 2-56 X 3/16	2
3	608A-28A	Shield: Bolometer	1
4	608D-28A	Insulator: Power Monitor Diode	1
5	8160-0008	Braid: Aluminum RF 1/2 IN. Dia	1
6	608D-20D	Housing: Generator	1
7	2390-0009	Screw: Machine BH SS 6-32 X 3/8	2
8	2190-0022	Washer: Lock Int. 11/16 IN. OD	4
9	2100-0009	Resistor: VAR 25K OHM 20% 1/3W	1
10	0360-0024	Lug: Terminal 3/8 IN.ID	1
11	2950-0030	Nut: Brass 3/8-32 X 9/16 IN. Wide	2
12	618B-12C	Bracket: Pot Mounting For R61 R62	1
13	2190-0016	Washer: Lock Int. 1/2 IN. OD	1
14	2100-0010	Resistor: VAR 2K OHM 20% 1/4W	1
15	3030-0006	Screw: Machine Allen DR 6-32 X 1/4 IN.	1
16	608D-59H	Cam: Frequency Adjust	1
17	1460-0020	Spring: Compression 7/16 IN. LG	1
18	608A-88	Washer: Bakelite	1
19	2950-0007	Nut: Brass 5/16-32 X 7/16	1
20	2190-0024	Washer: Lock Int. For 5/16 IN. Screw	1
21	608D-95A	Monitor Assembly: Power	1
22	0360-0010	Strip: Terminal	1
23	2500-0001	Nut: Brass 6-32 X 1/4 IN.	1
24	5020-0359	Shaft: 1/4 IN. Dia	1
25	5040-0223	Coupler: Flexible 3/8 IN. Dia	1
26	3030-0029	Screw: Cap Knurled 10-24 X 5/8	4
27	2190-0011	Washer: Lock Int. For No. 10 Screw	4
28	608D-47G	Spacer: Panel Left 1-3/4 IN. LG	2
29	608D-17D	Bushing: Frequency Adjust	1
30	3030-0001	Screw: Machine Allen DR 8-32 X 3/16	12
31	608D-99B	Cam: Dial Indicator	1
32	608D-47H	Spacer: Panel Right 2 IN. LG	2
33	608D-37P	Shaft: Frequency Adjust	1
34	608D-37S	Shaft: Turret Drive	1
35	0510-0005	Ring: Retaining For 1/4 IN. Shaft	1
36	2390-0007	Screw: Machine BH SS 6-32 X 5/16	2
37	1220-0009	Shield: Tube 9 Pin 1-5/16 IN. High	1
38	608D-42C	Crystal: Calibrate Assy	1
39	5020-0233	Collar: 1/4 IN. LG For 1/4 IN. Shaft	1
40	608A-27D	Filter: D.C.	2
41	608A-27B	Filter: Monitor	1
42	608A-27A	Filter: R.F.	1



608C/D-8-CS

Figure 9. hp Model 608C/D Signal Generator, Generator Housing

Ref.	(hp) Stock No.	Description	Qty.
1	0693-1231	Resistor: Fxd Comp 12K OHM 10% 2W	1
2	2360-0012	Screw: Machine RH SS 6-32 X 7/8	4
3	2190-0007	Washer: Lock Int. For NO. 6 Screw	4
4	0360-0005	Lug: Terminal For No. 6 Screw	1
5	608C-7P5	Stator: Oscillator Plate (608C Only)	1
5	608D-7P5	Stator: Oscillator Plate (608D Only)	1
6	608D-7G5	Stator: Oscillator Grid	1
7	608A-100V	Contact: Oscillator Grid	1
8	0150-0028	Capacitor: Fxd Ceramic 100 PF 10% 500VDCW	1
9	2360-0012	Screw: Machine RH SS 6-32 X 7/8 IN. LG	4
10	2190-0007	Washer: Lock Int. For No. 6 Screw	4
11	608C-5P6	Stator: Amplifier Plate (608C Only)	1
11	608D-7P6	Stator: Amplifier Plate (608D Only)	1
12	608D-7G6	Stator: Amplifier Grid	1
13	0693-4711	Resistor: Fxd Comp 470 OHM 10% 2W	1
14	N.S.N.	Shim Plate: 1/2 X 3/4 IN. Brass	1
15	608D-82	Mica Sheet: 11/16 IN. X 1-1/8 IN.	1
16	2390-0009	Screw: Machine BH SS 6-32 X 3/8 IN. LG	1
17	Part Of 16	Lockwasher	1
18	608D-58A	Contact: Amplifier Grid	1

Ref.	(hp) Stock No.	Description	Qty.
19	2390-0007	Screw: Machine BH SS 6-32 X 5/16	8
20	Part of 19	Lockwasher	8
21	0340-0006	Insulator Stand-Off 5/8 IN. X 1/2 IN. OD	8
22	2390-0009	Screw: Machine BH SS 6-32 X 3/8 IN.	1
23	Part of 22	Lockwasher	1
24	0360-0005	Lug: Terminal For NO. 6 Screw	1
25	0816-0002	Resistor: Fxd WW 3K OHM 10% 10W	1
26	2390-0001	Screw: Machine BH SS 6-32 X 1/2	1
27	Part Of 26	Lockwasher	2
28	0340-0020	Insulator: Stand-Off 3/4 IN. X 3/8 IN. OD	2
29		Not Assigned	
30		Not Assigned	
31	2950-0006	Nut: Brass 1/4-32 X 9/16 IN. (608D Only)	1
32	0150-0019	Capacitor: Fxd Ceramic 1000 PF 20% 500VDCW (608C Only)	3
32	0150-0019	Capacitor: Fxd Ceramic 1000 PF 20% 500VDCW (608D Only)	5
33	2950-0006	Nut: Brass 1/4-32 X 9/16 IN.	2
34	0133-0001	Capacitor: VAR Glass 0.5-3 PF (608C Only)	2
34	0133-0001	Capacitor: VAR Glass 0.5-3 PF (608D Only)	3
35	8160-0021	Braid: RF Brass 1/4 IN. DIA	1
36	608D-20H	Chassis	1

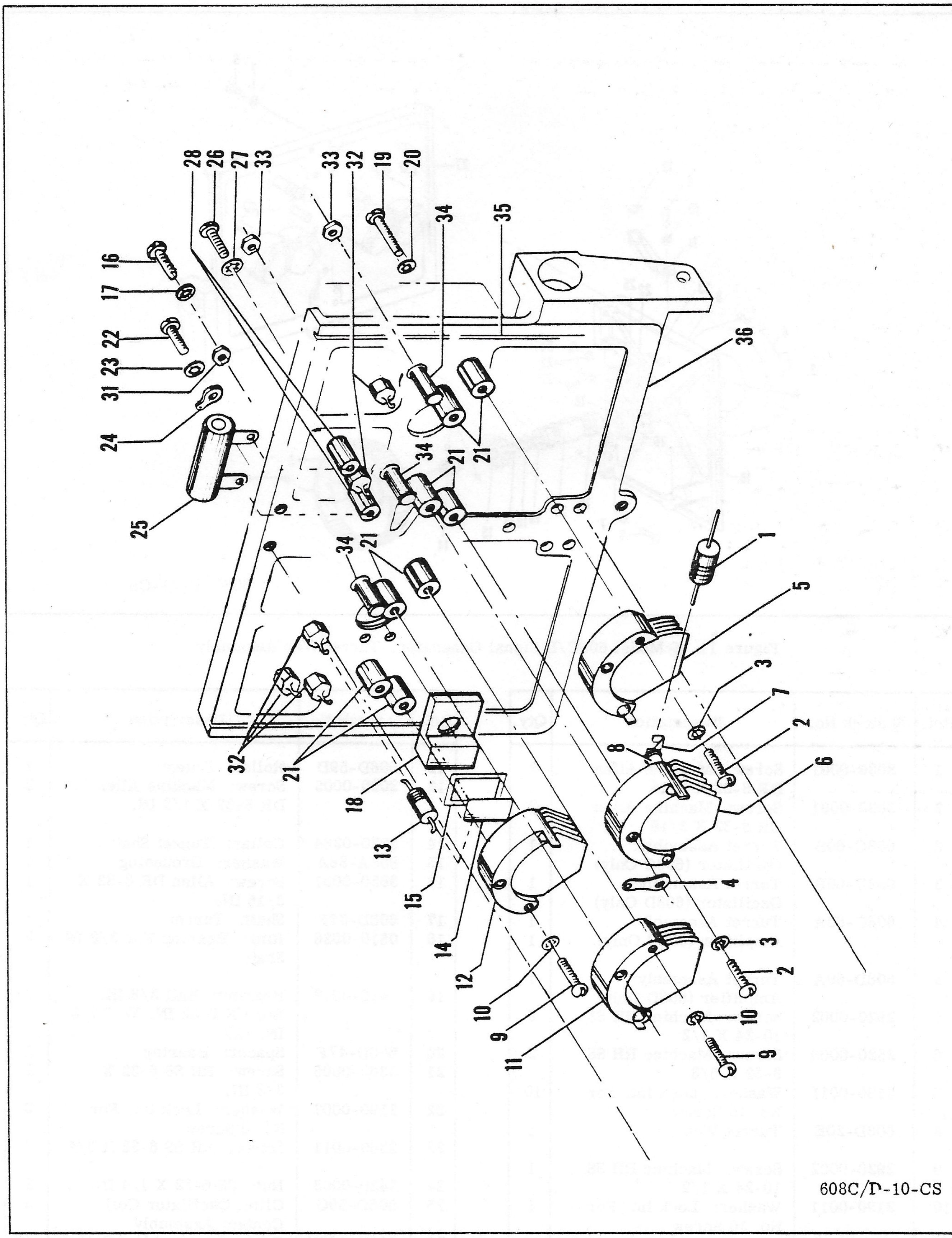


Figure 10. Model 608C/D Signal Generator, Bottom R. F. Generator Housing

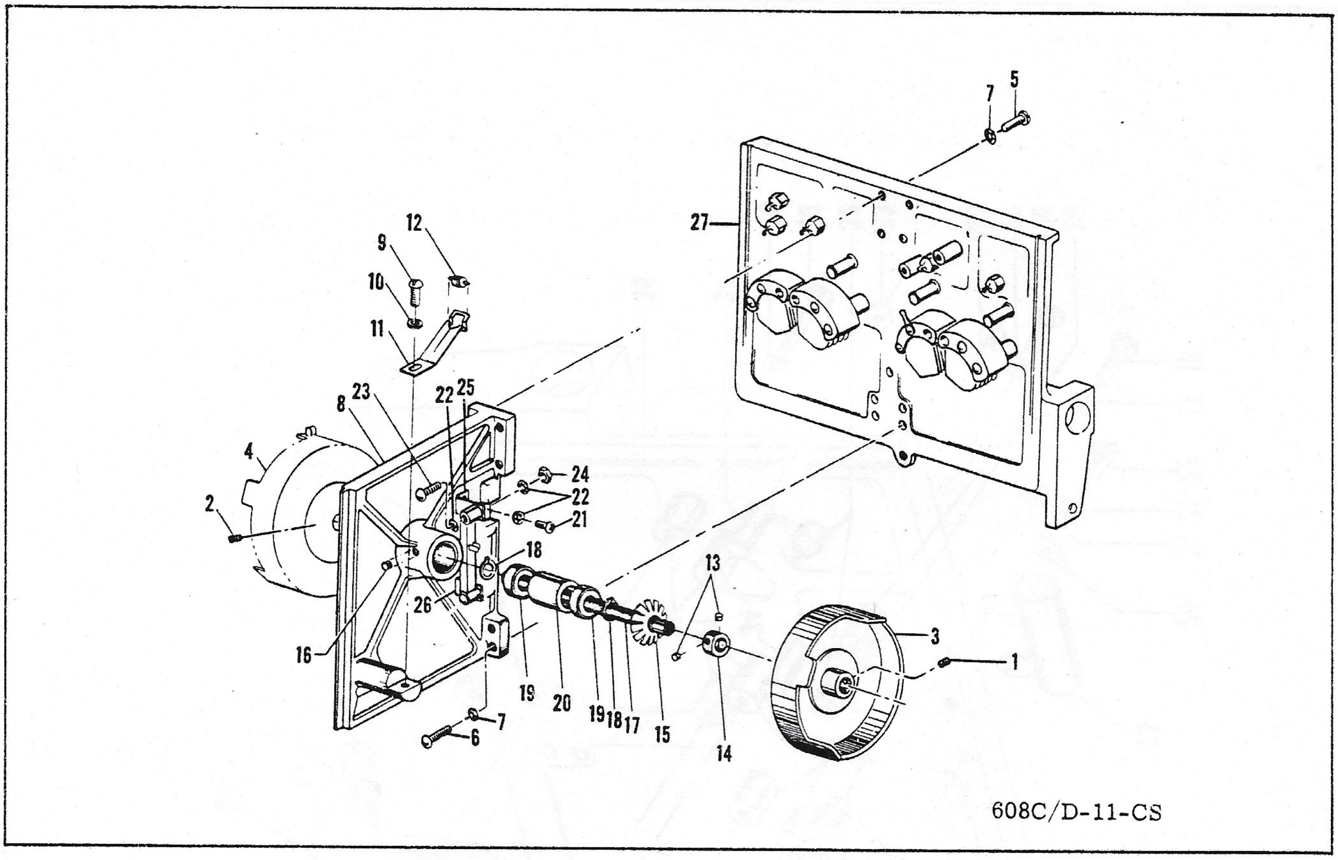


Figure 11. (hp) Model 608C/D Signal Generator, Turret Web Assembly

Ref.	(hp) Stock No.	Description	Qty.
1	3030-0001	Screw: Machine Allen DR 8-32 X 3/16	2
2	3030-0001	Screw: Machine Allen DR 8-32 X 3/16	2
3	608C-60B	Turret Assembly: Oscillator (608C Only)	1
3	608D-60B	Turret Assembly: Oscillator (608D Only)	1
4	608C-60A	Turret Assembly: Amplifier (608C Only)	1 1
4	608D-60A	Turret Assembly: Amplifier (608D Only)	1
5	2920-0002	Screw: Machine RH SS 10-24 X 1/2	8
6	2520-0006	Screw: Machine RH SS 8-32 X 5/8	2
7	2190-0011	Washer: Lock Int. For No. 10 Screw	10
8	608D-20E	Turret Web	1
9	2920-0002	Screw: Machine RH SS 10-24 X 1/2	1
10	2190-0011	Washer: Lock Int. For No. 10 Screw	1
11	608D-59C	Detent: Spring	1

Ref.	(hp) Stock No.	Description	Qty.
12	608D-59D	Roller: Detent	1
13	3030-0005	Screw: Machine Allen DR 8-32 X 1/8 IN.	2
14	5020-0284	Collar: Turret Shaft	1
15	803A-88A	Washer: Grounding	1
16	3030-0001	Screw: Allen DR 8-32 X 3/16 IN.	1
17	608D-37F	Shaft: Turret	1
18	0510-0028	Ring: Bearing For 3/8 IN. Shaft	2
19	1410-0012	Bearing: Ball 3/8 IN. Bore X 9/32 IN. W X 7/8 IN. OD	2
20	608D-47F	Spacer: Bearing	1
21	2360-0005	Screw: RH SS 6-32 X 3/8 IN.	2
22	2190-0007	Washer: Lock Int. For No. 6 Screw	2
23	2360-0011	Screw: RH SS 6-32 X 3/4	2
24	2420-0003	Nut: SS 6-32 X 1/4 IN.	2
25	608D-59G	Clip: Oscillator Coil Contact Assembly	2
26	608D-100K	Contact Assembly: Coil	1
27	608D-20H	Chassis	1

SERVICE NOTE

SUPERSEDES:

608D-4

HP MODEL 608C/D VHF SIGNAL GENERATORS

608C Serials Below 2354
608D Serials Below 4916

SILICON RECTIFIER CONVERSION KIT 608D-95C

Silicon diode rectifiers can be easily installed in place of the selenium rectifiers in the power supply of your HP Model 608C/D VHF Signal Generators, serials listed above. Silicon diode rectifiers are cool operating, compact, and offer increased instrument reliability. In addition, component replacement becomes easier and more economical since each branch of the full-wave rectifier bridges is an individual diode.

Conversion requires removing the selenium rectifiers, mounting the silicon diode rectifier board assembly, adding two large resistors, and wiring. Adjustment of regulated voltages completes the procedure.

A complete kit of components, partly assembled for simple installation, is available under HP Part Number 608D-95C. Modification of your instrument with this kit is recommended when the original selenium rectifiers require replacement.

COMPONENTS FURNISHED IN HP PART NUMBER 608D-95C KIT

Quantity	Description	HP Part Number
1	Resistor board and rectifier assembly, includes four HP Part Number 1901-0028 silicon diodes CR12 thru CR15 and four HP Part Number 1901-0029 silicon diodes CR8 thru CR11	608D-75T
1	Resistor, 100 ohms, ±10%, 20 watt, wirewound	0819-0019
1	Resistor, 60 ohms, ±5%, 40 watt, wirewound	0818-0027
4	Machine screws, 6-32 x 3/4 inch, binding head, brass NI	2470-0003
5	Hex nuts w/lockwasher, 6-32 x 5/16 inch, steel NI	2420-0001
2	Split lockwashers, #6 x 5/64 inch, phos B	2190-0018
1	Machine screw, 6-32 x 2-1/2 inch round head, brass NI	2440-0007
2	Cup washers, 1/2 inch O.D., brass NI	3050-0088
1	External lockwasher #8, phos B NI	2190-0010
3	Internal lockwashers, #6, phos B NI	2190-0007
1	Flat washer, #6, brass NI	3050-0100
1	Solder lug, #10, 7/8 inch x 5/16 inch, brass, tinned	0360-0007
1	Violet wire, 6 inches long, #22, stranded	8150-0030
1	Service Note 608D-4A	

JD/mh/wo

Rev. 6/69-4

HEWLETT hp PACKARD

INSTALLATION PROCEDURE

1. Disconnect power and remove cabinet.

2. Disconnect all wires (violet, pink, and gray) from selenium rectifiers, CR4, CR5, and CR6 including ground wire to CR4 and CR5.

3. Loosen end nuts, remove and discard selenium rectifiers CR4, CR5, and CR6.

4. Remove and discard mounting bracket for CR4 and CR5 nearest side of chassis. The bracket in center of chassis is used to mount the 100 ohm resistor, R125.

5. Remove and discard both mounting brackets for CR6.

6. Refer to Figure 1 for typical parts locations and mounting details.

7. Drill two #26 (.147 in.) holes on side of chassis for mounting the 60 ohm resistor, R124. Mount R124.

8. Install the 100 ohm resistor, R125, using the upper notch of remaining selenium rectifier bracket as a mounting point.

9. Unsolder and discard the two inch violet wire from silicon rectifier board assembly. Replace this section with the 6 inch violet wire furnished in the kit.

10. Unsolder and discard 4-1/2 in. pink wire from the silicon rectifier board assembly. This wire will be replaced during wiring by existing pink wire from the 80 μF capacitor, C42.

11. Position silicon rectifier board assembly as shown in Figure 1. Drill an additional #26 (.147 in.) hole about 3-1/2 in. above existing hole (use board as template). Dress the two long pink and the two long violet wires behind silicon rectifier board. Slide these wires thru chassis hole toward power transformer T1.

12. Mount rectifier assembly board.

13. Unsolder and discard violet wire from terminal B-1 on T1. Connect violet wire from junction of CR8 and CR9 on rectifier board to terminal B-1 on T1.

14. Unsolder and discard violet wire from terminal B-2 on T1. Connect violet wire from junction of CR10 and CR11 to terminal B-2 of T1.

15. Unsolder and discard pink wire from terminal B-4 on T1. Solder the pink wire from junction of CR12 and CR13 to terminal B-4 on T1.

16. Unsolder and discard pink wire from terminal B-5 on T1. Solder pink wire from junction of CR14 and CR15 to terminal B-5 on T1.

17. Solder a #10 ground lug to the short black wire from CR8. Mount ground lug on nearest chassis screw.

18. Connect existing gray wire from C42 to one end of the 100 ohm resistor, R125.

19. Connect gray wire from CR13 to other end of R125.

20. Connect existing pink wire from C42 to junction of CR14 and CR12 on rectifier board.

21. Connect existing violet wire from C40 to one end of the 60 ohm resistor, R124.

22. Connect violet wire from junction of CR11 and CR9 on rectifier board to other end of R124.

23. Check your wiring with Figure 2.

ADJUSTMENT

24. Turn instrument ON. Measured regulated dc voltages should be -165V and +225V. Check regulation and ripple. Use a VTVM, such as a HP Model 400D/H/L, to measure filament voltage (ac) of the RF oscillator and amplifier tubes at filter FL1: 608C should be 7.4V; 608D should be 7.6V (this corresponds to 6.3V at the tube filaments).

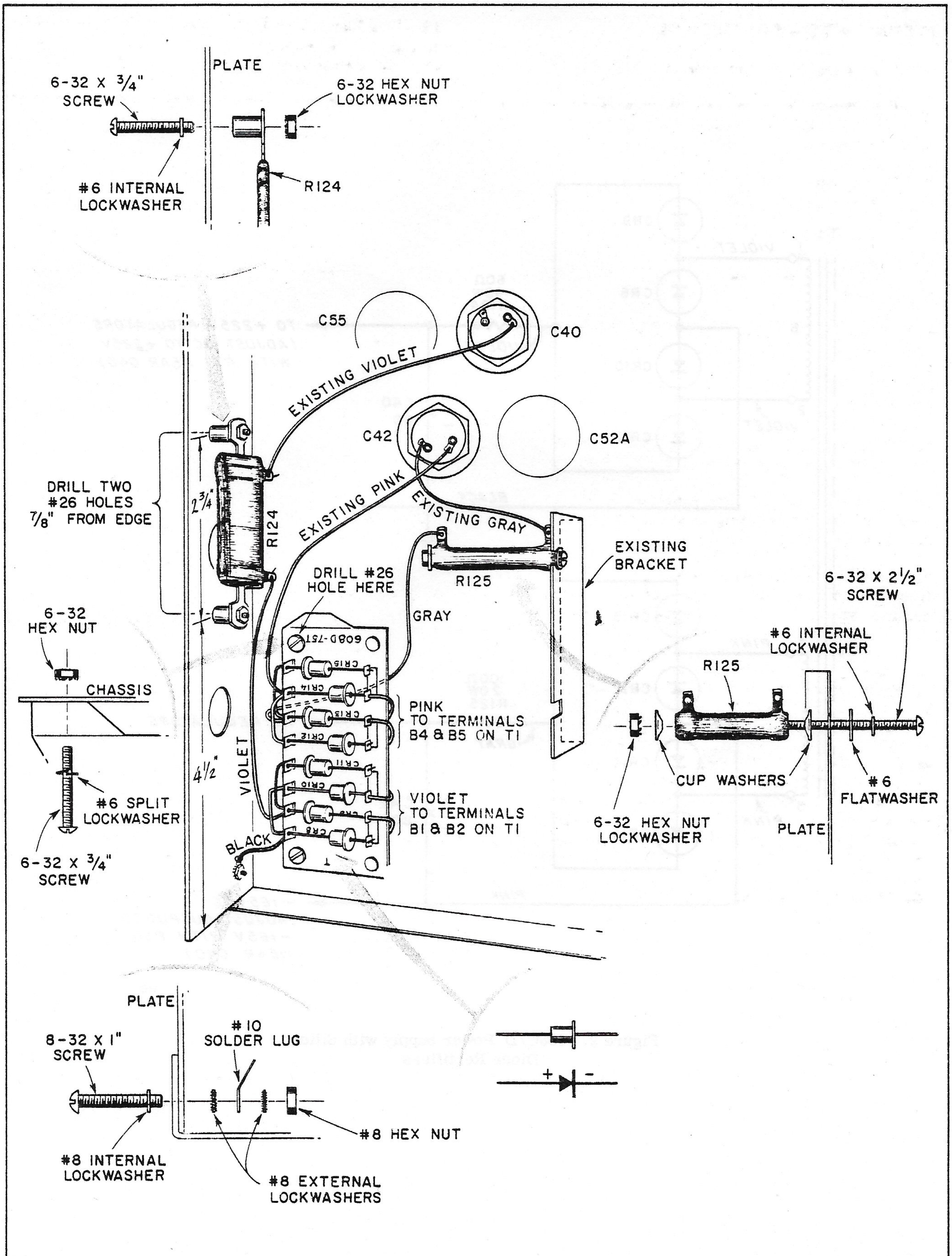


Figure 1. Silicon Rectifiers in Models 608C/D

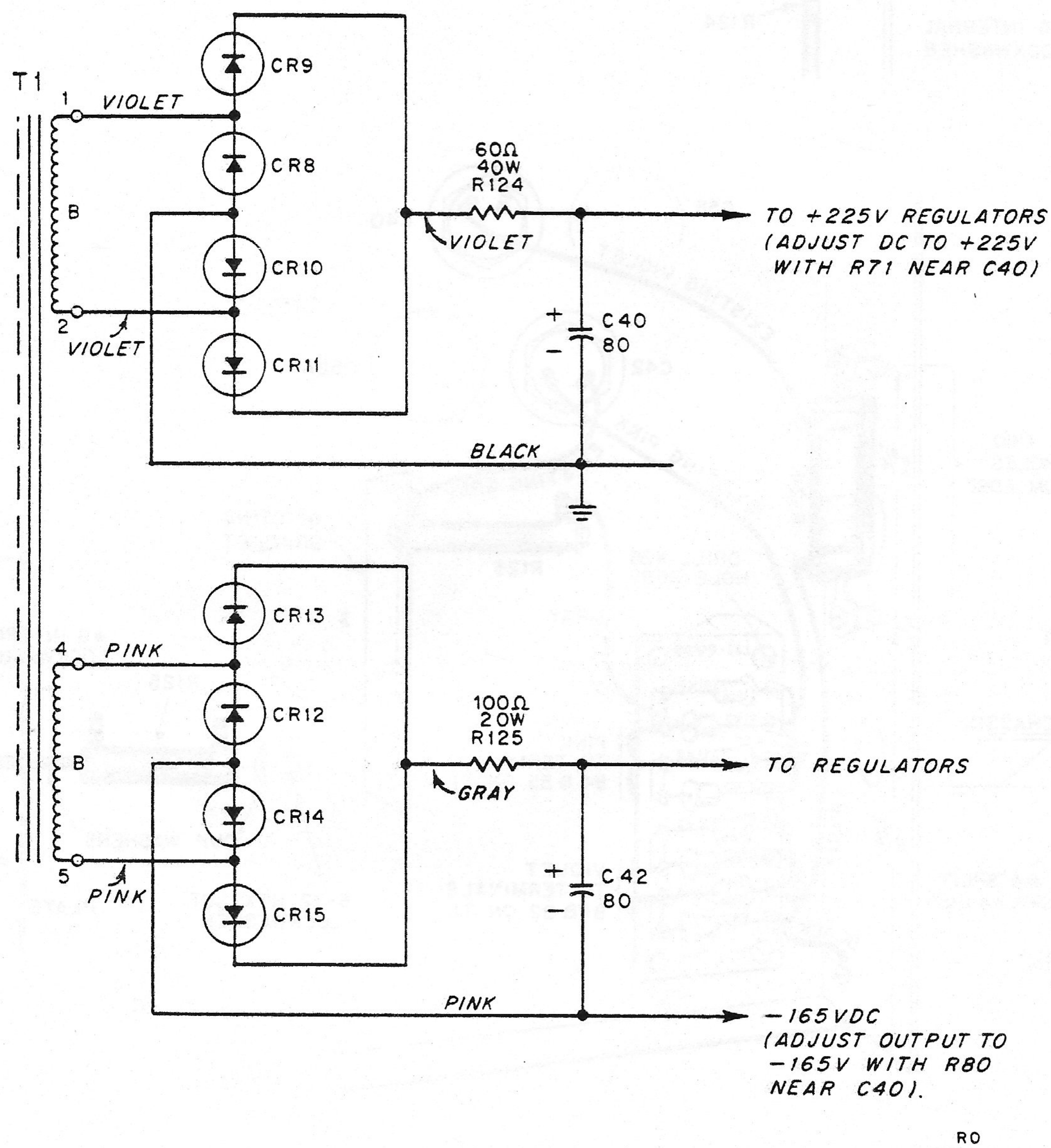


Figure 2. 608C/D Power Supply with Silicon Diode Rectifiers

SUPERSEDES:
608C/D/E/F-2A

HP MODEL 608C/D/E/F VHF SIGNAL GENERATORS

608C Serials Below 832-07365
608D Serials Below 828-12506
608E Serials Below 826-01221
608F Serials Below 827-00951

MODIFICATION FOR MODULATION OSCILLATOR CIRCUIT, V2

If you have problems with the internal modulation oscillator in 608C/D/E/F Signal Generators, serials listed above; or if the oscillator tube V2 should fail the following modification is suggested. The modulation oscillator circuit in these instruments has always been very sensitive to tube parameters requiring careful tube selection for proper operation. This modification eliminates the need for tube selection allowing any type 12AU7, HP Part Number 1932-0029, to be substituted. It also improves carrier envelope distortion and reduces the change in output voltage that occurs when switching between 400 Hz and 1000 Hz internal modulation frequencies. (See also Service Note 608C/D/E/F-8). Remove Service Note 608C/D/E/F-2A from your files.

PARTS REQUIRED FOR MODULATION:

Quantity	Description	HP Part Number
1	Fixed Resistor, Composition, 150KΩ, 10%, 1W.	0690-1541

MODIFICATION PROCEDURE:

1. Make certain power is OFF by disconnecting line cord.
2. Remove the 100KΩ resistor R12 now connected between PIN 6, plate of V2A, and PIN 8, cathode of V2A.

JD/jr/wo 8/69-4

3. Connect 150KΩ resistor R12 between PIN 6, plate of V2A, and PIN 1, plate of V2B. (R12 retains same reference designation).

4. Perform the Internal Modulation Performance Tests found in your Operating and Service Manual, and correct the Parts List and Schematics in your manual to show this modification.

HP MODEL 608C/D VHF SIGNAL GENERATORS

HP 608C Serials Below 247-04756

HP 608D Serials Below 247-08115

9 June 66-4

MODIFICATION FOR REGULATED DC FILAMENT OPERATION

This Service Note outlines the procedure for modifying the HP Model 608C/D VHF Signal Generators for regulated DC filament operation of the the RF circuits.

The original multivibrator filament power supply in some cases caused ripple on the output RF signal from the generator. The DC filament supply prevents this from happening.

The modification consists of removing the multivibrator supply and installing the regulated DC power supply. The filament windings are then rewired to provide 12.6 VAC isolated from ground for driving the regulated DC filament supply.

No recalibration of the signal generator is required when the modification is completed.

PART FURNISHED IN MODIFICATION KIT 608C-95A or 608D-95J

Quantity	Description	HP Stock No.
1	Capacitor, Fixed 1000 mf 25 vdcw	0180-0057
1	Plate, Transistor	1200-0043
2	Bushing, Transistor	1200-0081
1	Transistor	1850-0087
1	Bracket, capacitor	608D-12R
1	Rectifier, Board Assembly or Rectifier, Board Assembly	608D-75H or 608C-75H
1	Socket, Lamp	1450-0009
2	Flat Washer, #4	3050-0016
1	Terminal Lug	0360-0016
2	Machine Screw, Binding Head w/Lockwasher, 6-32 x 3/8"	2390-0009
2	Machine Screw, 4-40 x 1/2", Round Head	2200-0009
2	Nut, Hex, w/Lockwasher, 6-32	2420-0001
2	Nut, Hex, 4-40	2260-0002
2	Lockwasher, #4	2190-0004
1	Gray Wire #22 Gauge, 90" length	8150-0027
1	White Wire, #22 Gauge, 22" length	8150-0033
1	Brown Wire #22 Gauge, 90 inch length	8150-0007
1	Black Wire, #22 Gauge, 4 inch length	8150-0005
1	Violet Wire, #22 Gauge, 3 inch length	8150-0030
1	Brown Wire, #18 Gauge, 25 inch length	8150-0086
1	Brown-Orange Wire, #22 Gauge, 23 inch length (not required in 608C modification)	8150-0009

MODIFICATION PROCEDURE

NOTE

For 608C modification, substitute 608C-75H for 608D-75H. Delete step 27. In the following procedure, (NS) means do not solder connection. (S1) means solder connection. Number indicates number of wires on connection.

1. Disconnect power, remove cabinet cover.

2. Disconnect all wires on transformer T2. Remove T2, Attenuator Cable Shield, and T2 Mounting Bracket.

NOTE

If the mounting bracket is held on with PEM fasteners, it will be necessary to loosen the nuts supporting T1 so T1 can be tipped out of the way. This will allow removal of the screws holding the mounting bracket. It is not necessary to completely remove the nuts supporting T1.

3. Mount capacitor bracket 608D-12R where T2 bracket was located. Use 6-32 hardware. Tighten nuts holding T1.

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Printed in U.S.A.

4. Remove all leads from XV17. Use #27 drill to drill out rivets holding XV17. Remove socket.

5. Remove resistor board assembly 608D-75C and discard. Remove all red wires connected to R87 from instrument.

6. Disconnect shielded cable and discard from FL-1.

NOTE

Refer to Figures 1 and 2 for the following wiring steps.

7. Mount transistor Q1, 1850-0087, at location of XV17. Slot one hole with a #27 drill to ease mounting of Q1. Make sure collector is not grounded.

8. Mount rectifier board assembly 608D-75H at location of 608D-75C.

9. Mount capacitor C75, 1000 mf, 25 vdc. Do not mount attenuator cable shield at this time.

10. Connect a white wire from emitter of Q1 (S1) to FL1.

11. Run green wire on 608D-75H to base of Q1 (S1). Leave remaining wires on 608D-75H disconnected.

12. On transformer T1, remove connection from D5 to ground.

13. Connect a jumper from terminal C2 (S2) to terminal D1 (S3) on transformer T1.

14. Connect a brown wire #22, 24" length to terminal C1 on T1 (S2).

15. Connect a gray wire 24" length to terminal D2 on T1 (NS).

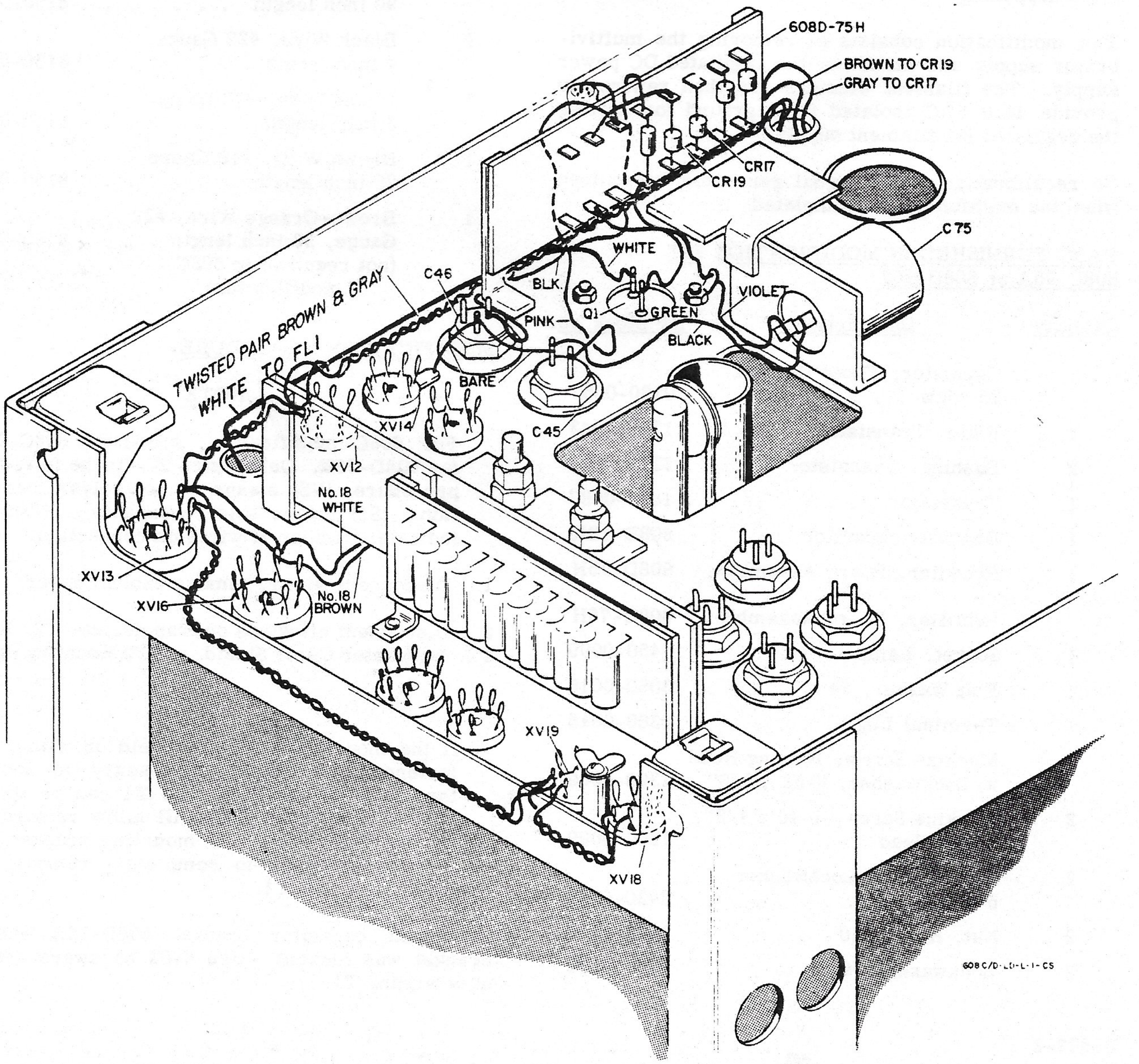

Figure 1. Model 608C/D DC Filament Installation

16. Run brown and gray wire from T1 through 3/4" hole at lower left of T1. Follow black and white wires to opposite side of chassis. Then run the brown and gray wires through the 1/2" hole in the lower right hand corner at the rear of the chassis. Follow cable harness. Run wires under 608D-75H. Connect gray wire to junction of CR-17 and CR-18 (S2). Connect brown wire to junction of CR-19 and CR-16 (S3).

17. Run pink wire on 608D-75H between 608D-75H and chassis. Connect to negative side of C45 (S3).

18. Rotate C46 so red terminals are vertical and nearest to chassis edge. Connect negative on C46 (NS) to ground lug on XV14 (S1).

19. Run black wire on 608D-75H between 608D-75H and chassis. Connect to negative on C46 (S3).

20. Connect black wire 4" length from positive of C75 (S1) to grounded side of C45(S2).

21. Connect a violet wire, 3" length to negative side of C75 (S1).

22. Run violet wire on 608D-75H between 608D-75H and chassis. Connect violet wire from 608D-75H and violet wire on C75 to collector terminal lug on Q1 (S2). Replace attenuator shield.

23. Remove ground connections from pin 3 of XV12, XV14, XV18, and XV19, and from pin 8 of XV13 and XV16. Disconnect white wire #22, from pin 4 of XV18, XV19, XV12, and XV14. Remove from instrument.

24. Disconnect black wire from pin 8 of XV16 and connect to ground lug on XV16 (S1).

25. Connect brown wire #18, 25" length, to terminal D2 of T1 (S3). Follow white lead on terminal D1 of T1 up to tube socket XV16. Connect brown wire to pin 8 of XV16 (NS).

26. Disconnect and discard #22 white wires from pin 7 of XV13.

27. Connect brown-orange wire 23" length to terminal C4 on T1 (S3). Run wire through 3/4" hole at lower left of T1, across to other side of chassis, and up to FL4 (S1).

28. Connect brown wire #18, 3" length, between pin 8 of XV16 (S2) and pin 8 of XV13 (NS).

29. Make a length of twisted pair 56" long. Use #22 gray wire and #22 brown wire.

NOTE

In following instructions, connect brown wire to pin 3 and gray wire to pin 4. On XV13 connect gray wire to pin 7, brown wire to pin 8. Use lengths of twisted pair as indicated.

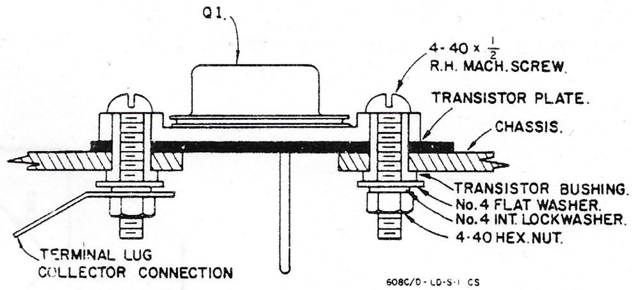

Figure 2. Transistor Q1 Mounting

30. Connect a 3" length from pins 3 and 4 of XV18 (S1) to pins 3 and 4 of XV19 (NS).

31. Connect an 8" length from pins 3 and 4 of XV19 (S2) to pins 7 and 8 of XV13 (NS).

32. Connect a 4" length from pins 7 and 8 of XV13 (S3) to pins 3 and 4 of XV12 (NS).

33. Connect a 3" length from pins 3 and 4 of XV12 (S2) to pins 3 and 4 of XV14 (NS).

34. Connect a 30" length of twisted pair to pins 3 and 4 of XV14 (S2). Follow cable harness down toward bottom right hand corner of chassis through 1/2" hole toward front panel.

35. Remove all wires presently connected to power lamp socket, XI4, from instrument.

36. Connect twisted pair to XI4 (NS).

37. Remove Frequency Dial knob. Remove and discard dial illuminating lamp socket XI3.

38. Connect an 8" length of twisted pair to the terminals of lamp socket part 1450-0009 (S1) on each terminal. Mount socket in place of XI3. Replace Frequency Dial knob.

39. Run twisted pair on XI3 over to XI4 and connect (S2) on each terminal of XI4.

40. This completes the rewiring. Check wiring for accuracy.

41. Turn the signal generator on measure voltage at outside of FL-1, should be 6.8 vdc for hp Model 608D; 6.5 for hp Model 608C.

42. This completes the modification. Turn power off. Replace instrument cabinet.

The attached partial schematic, Figure 3, should be added to your Operating and Service Manual for future reference.

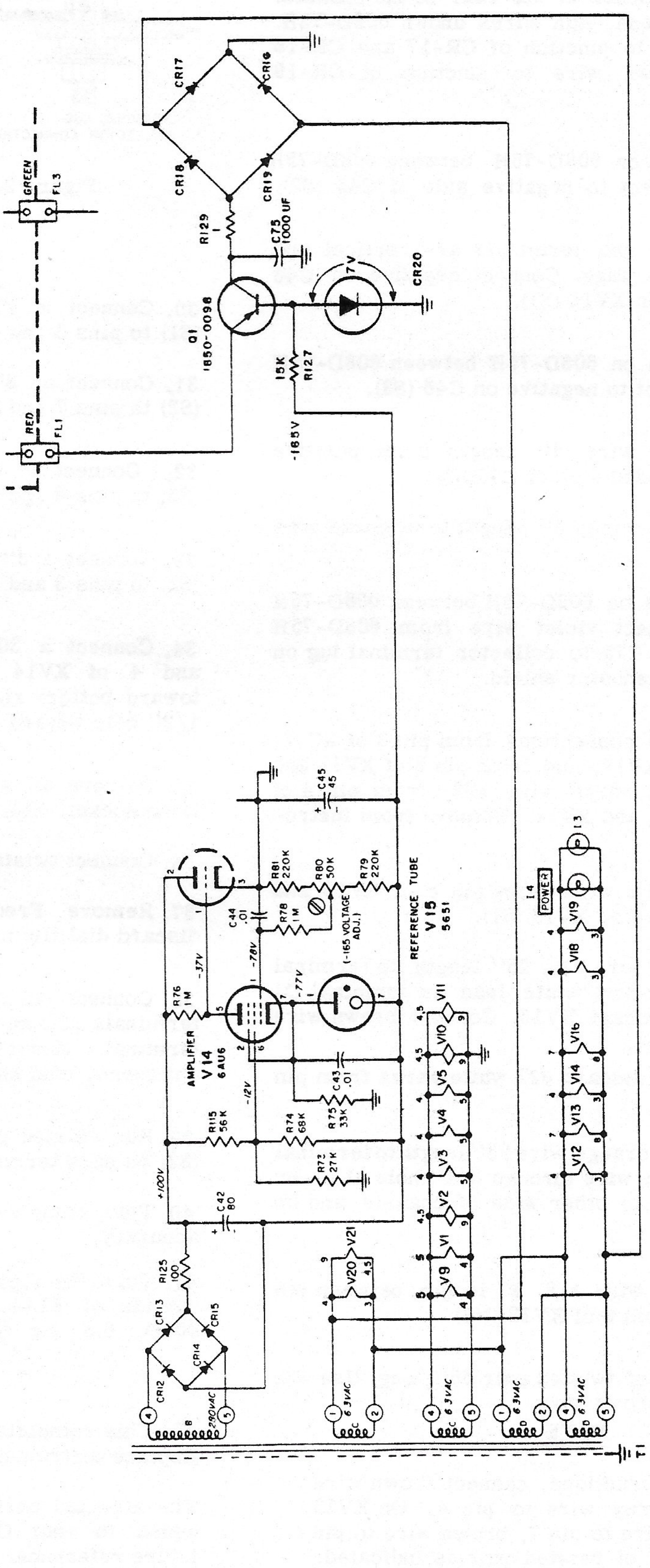

Figure 3. hp Model 608C/D VHF Signal Generator

SERVICE NOTE

SUPERSEDES:

None

HP MODEL 608C/D/E/F VHF SIGNAL GENERATORS

608C Serials Between 247-04756 and 548-06809

608D Serials Between 247-08115 and 548-11960

608E/F Serials Below 610-00225

IMPROVED DC FILAMENT SUPPLY PROTECTION

This Service Note provides the information needed to add fuses to the DC Filament supply for improved circuit protection. The fuses prevent the possibility of damage to the filament wiring harness if a diode in the DC Filament Supply Rectifier Bridge should short. This modification applies to the 608C/D/E/F Signal Generators, serials listed above, plus any earlier 608C/D Generators that have been modified for DC Filaments. (See Service Note 608C-2A.)

The modification consists of adding fuse holders and mounting plate on the rear chassis of the generator. No special tools are required for this procedure. No recalibration is required after the fuses are installed.

PARTS INCLUDED IN FUSE MOUNT KIT, HP PART NUMBER 00608-60035:

Quantity	Description	HP Part Number
2	Fuseholder	1400-0008
2	Fuse, 3 AMP	2110-0003
1	Fuse Mounting Plate	00608-20003

MODIFICATION PROCEDURE:

1. Disconnect Power. Remove Cabinet.
2. Install Fuse Mounting Plate and Fuse Holders at bottom center of rear chassis. Use chassis mounting screw already in instrument.
3. Disconnect Gray wire from junction of CR16 and CR19, disconnect Brown wire from junction of CR17 and CR18 on DC Filament Supply Assembly mounted at lower right side of rear chassis.
4. The Brown and Gray wires must be removed from the cable harness all the way back to transformer T1.
5. Re-route the wires through the grommeted hole just below the Rectifier Assembly at the lower left of rear chassis.
6. Route wires to fuse holders. Cut to length. Connect Brown wire to one fuse holder and Gray wire to other.
7. Connect remaining wires to other side of fuse holders so fuses will be in series with filament leads. Install fuses.
8. Route Gray and Brown wires to Filament Rectifier Assembly. Cut to length.
9. Connect Gray wire to junction of CR16 and CR19. Connect Brown wire to junction of CR17 and CR18.

This completes the modification. The Parts Lists and Schematic in your Operating and Service Manual should be corrected to show the new parts.

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SERVICE NOTE

608C-1

HEWLETT-PACKARD VHF SIGNAL GENERATOR MODELS 608C & 608D

IMPORTANT LUBRICATION NOTICE

CALIBRATION ACCURACY AND INSTRUMENT DEPENDABILITY CAN BE MAINTAINED ONLY BY PROPER LUBRICATION OF THE TWO WORM GEARS IN THE TUNING MECHANISM OF THESE INSTRUMENTS. THIS IS PARTICULARLY TRUE WHEN THE INSTRUMENT IS OPERATED CONTINUOUSLY OR FOR SEVERAL HOURS DAILY. THE WORM GEAR FOR THE RF OSCILLATOR CAPACITOR DRIVE AND THE RF AMPLIFIER DRIVE SHOULD BE CLEANED AND RELUBRICATED APPROXIMATELY EVERY 60 DAYS. REFER TO THE OPERATION AND SERVICING MANUAL SUPPLIED WITH THE INSTRUMENT FOR LUBRICATION INSTRUCTIONS. ALL OTHER POINTS REQUIRING LUBRICATION SHOULD BE LUBRICATED AT THE INTERVALS GIVEN IN THIS SAME MANUAL.

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SERVICE NOTE

P-608A-34 (Rev. 2/69)

HP PART NUMBER 608A-34, 608D-34, 608D-34S, AND 00608-610
REPLACEMENT ATTENUATOR ASSEMBLY

This Service Note contains information necessary for replacing and recalibrating the output attenuator in the 608A/B/C/D/E/F Signal Generators. The procedure is described for each model, using the appropriate replacement attenuator.

EQUIPMENT REQUIRED

A microwave power meter and thermistor mount such as HP Model 432A, 478A combination will be required for calibration.

NOTE

Should it be necessary to replace the drive cable, a new drive cable and drive screw assembly is available under HP Part No. 5060-0205.

DESCRIPTION

The RF power output from the power amplifier is obtained from the resonant plate circuit by means of a pickup loop located in a section of circular waveguide which opens adjacent to the resonant circuit. The waveguide is smaller than the cut-off size of waveguide designed for use at the frequencies generated by the Model 608 and the energy propagation decreases linearly in dB down the waveguide.

A pulley drive system moves the pickup loop in the waveguide. The energy coupled into the output system varies with the position of the pickup loop.

The attenuator dial is calibrated directly in dB below 1 milliwatt into 50 ohms. A second scale on the attenuator dial is calibrated directly in millivolts and microvolts output across a 50 ohm resistive load.

The pickup loop couples energy from the resonant circuit to the output connector through a special matching network. This network consists of two resistors and a small variable capacitor. The setting of this capacitor primarily determines the standing wave ratio at the instrument output terminals. Do not disturb the factory setting of this capacitor or the position of other components on the end of a replacement attenuator.

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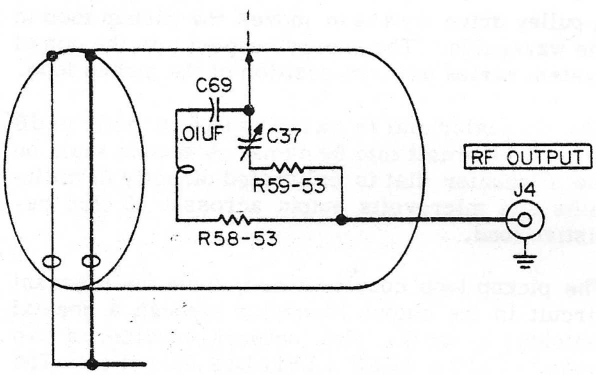
NOTE

Since 1956 HP attenuator probes have included a capacitor (C69) in the probe to block ground loop currents between the probe ground and the front panel ground. See 608C/D Probe Schematic. This eliminates spurious signals which could appear at the signal generator output. C69 is a .01 μF 400 volt Mylar capacitor. It was added to the circuit in series between the probe pickup loop and the probe body which is ground. Because of this capacitor, a dc resistance check of the probe between the center conductor of the jack and ground will indicate an open circuit which is normal. A VHF impedance bridge such as the HP 803A may be used to verify impedance of the probe assembly.



Probe Schematic (608C/D)

If excessive power is accidentally applied to the attenuator circuit from an external source, the precision resistors on the output attenuator will be damaged and in most cases burned out. Fuseholder HP Part No. 11509A is available as an accessory to prevent output attenuator damage.

REPLACEMENT PROCEDURE

1. Remove cabinet.

2. Release or Remove Drive Cable from Attenuator:

a. If drive screw (1) is slotted, remove nut and pin; slide cable (2) out of slot.

b. If drive screw (1) is not slotted, or if cable (2) is frayed, cut cable (2), remove, and discard.

NOTE

Before removing drive cable, note routing of cable and compare with step 5. This will make drive cable replacement easier.

3. Remove Attenuator:

a. Completely remove attenuator drive screw (1) by unscrewing from attenuator. (First remove lock nut from end inside tube.)

b. Pull attenuator out of attenuator tube (3). (Waveguide.)

c. Release attenuator output cable (4) from chassis by removing clamp.

d. Unscrew knurled sleeve on rear of front panel output connector.

e. Pull output connector back from panel and then out through hole in rear of chassis. Cut out or remove rubber grommet (608A/B only). A new grommet is supplied on the new attenuator cable.

4. Install Attenuator in Tube (3):

a. Check attenuator fingers (8). They should project 1/6" to 1/32" past side of attenuator. (If too tight, attenuator will not move freely. If too loose, will cause RF leakage.) Adjust if necessary. If necessary, the fingers can be burnished for smoother operation.

b. Line up drive screw hole with slot (5) in tube (3).

c. Compress fingers and insert attenuator into tube.

d. Install drive screw, using new slotted type. This makes future replacement easier.

e. Make sure fingers do not catch at forward end of drive screw slot. Bend a finger in toward attenuator as necessary.

f. Align drive screw, drive screw slot, and rear pulley (9) so cable will run straight.

g. Pass connector through chassis and replace on panel.

h. Secure cable clamp, forming cable toward corner near 1/16 Amp. fuse. If this is not done, cable will hit back of case and prevent proper operation.

5. Replace Drive Cable if Necessary:

a. Turn attenuator dial to extreme counterclockwise position.

b. Face right rear corner of instrument.

c. Pass end of drive cable through top hole (11) in drive pulley (12) and secure end under screw (14).

d. Pass free end up over pulley, around upper idler pulley (15) through slot in drive screw (1), around rear idler pulley (9), around lower idler pulley (16), and out the side under the drive pulley.

NOTE

For the following three steps obtain help, or secure the drive pulley to the stop (with wire or string) in the clockwise position.

e. Keeping the tension on cable, turn attenuator to extreme clockwise position. This winds up one turn on drive pulley.

f. Pass free end under drive pulley and into hole (17).

g. Secure end of drive cable under screw (18), keeping cable taut.

6. Replace Drive Cable in Slot, and Adjust for Optimum Tension:

a. Loosen Allen screw in rear pulley (9) assembly.

b. Pull back on pulley to get desired tension. (If the cable is too tight, the attenuator will not move freely. If too loose, there will be backlash).

c. Tighten Allen screw.

7. Secure Drive Cable to Attenuator:

a. Set attenuator dial at extreme clockwise position.

b. Remove side cover plate and gasket from generator casting.

c. Lift drive cable out of slot and thread one 10-32 hex nut on the attenuator drive screw.

d. Place one fiber washer over the attenuator drive screw and then insert drive cable in the drive screw slot.

e. Plate the remaining fiber washer over drive screw followed by the second 10-32 hex nut. Position the two nuts so that when they are tightened later the cable will be clamped between the two fiber washers in a straight line between pulleys 9 and 15.

f. Slide attenuator forward until the pickup loop (19) is flush with inner end of tube.

g. Tighten nuts on attenuator drive screw.

h. Make sure that these nuts do not hit rear pulley assembly in counterclockwise position of the attenuator control.

i. Check pickup loop position with attenuator control full clockwise. Loop should be flush with inner end of tube.

j. Check amplifier turret and coils. They must not touch the pickup loop when the range switch is operated.

8. 608A/B Attenuator: (Calibration for Models 608C/D refer to appropriate Operating and Service Manual.)

a. Turn attenuator dial to extreme clockwise position.

b. Make sure dial reads exactly +7 dB. If not, loosen attenuator dial knob and reset.

c. Turn dial to indicate exactly -1 dB.

d. Apply power to instrument.

e. Connect bolometer mount and power meter to the Model 608.

f. Set Model 608 to 10 MHz and peak trimmer.

g. Set output level control until external power meter indicates exactly -1 dB.

h. Adjust R20 potentiometer on bracket at rear of generator casting, so that output meter on Model 608 indicates exactly 0.5 volts.

i. Check all bands for correct power output.

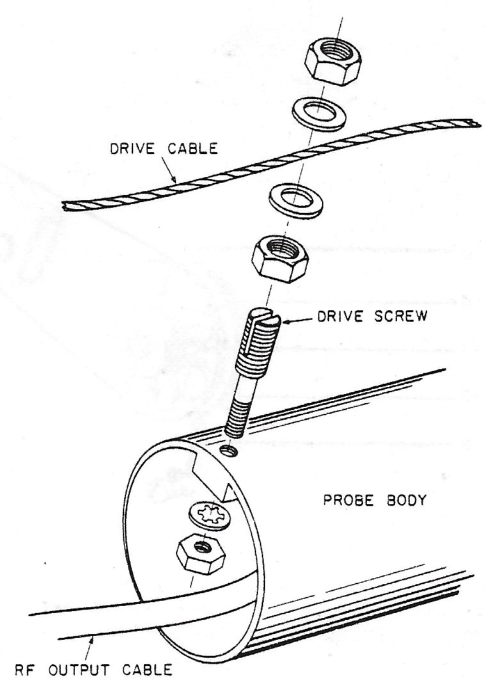
j. Reset attenuator dial to +7 dB and adjust output to Set Level.

k. Check all bands for correct power output. Measured output should be +7 dB plus or minus 1 dB.

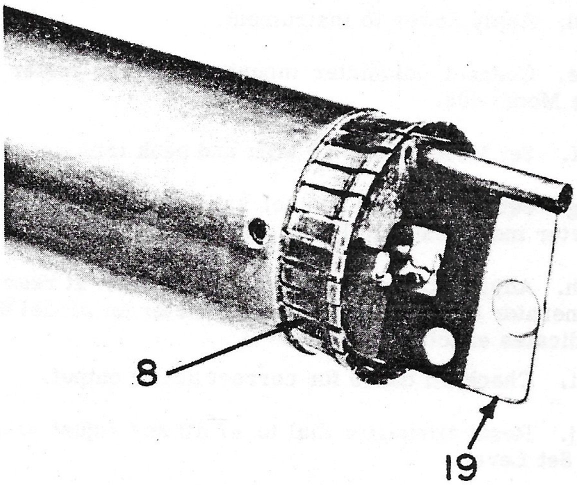
m. Readjust R20 if necessary to compromise for errors noted in these measurements.

NOTE

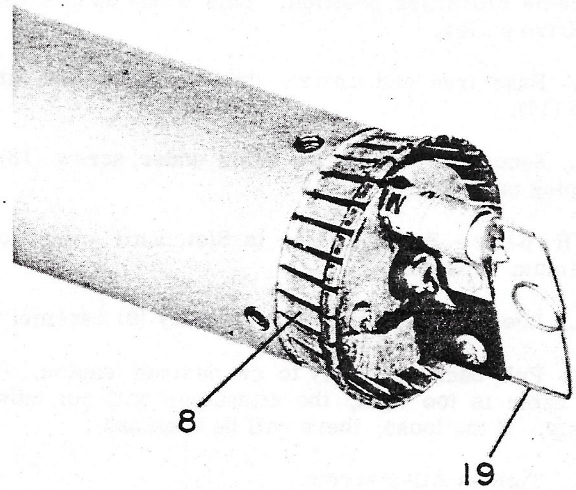
Errors at the -1 dB level should be kept as small as possible since the accuracy of this setting determines the accuracy at lower attenuator settings. The attenuator is very linear below 0 dB but due to end fringe effects of the attenuator tube, there is some non-linearity above 0 dB.



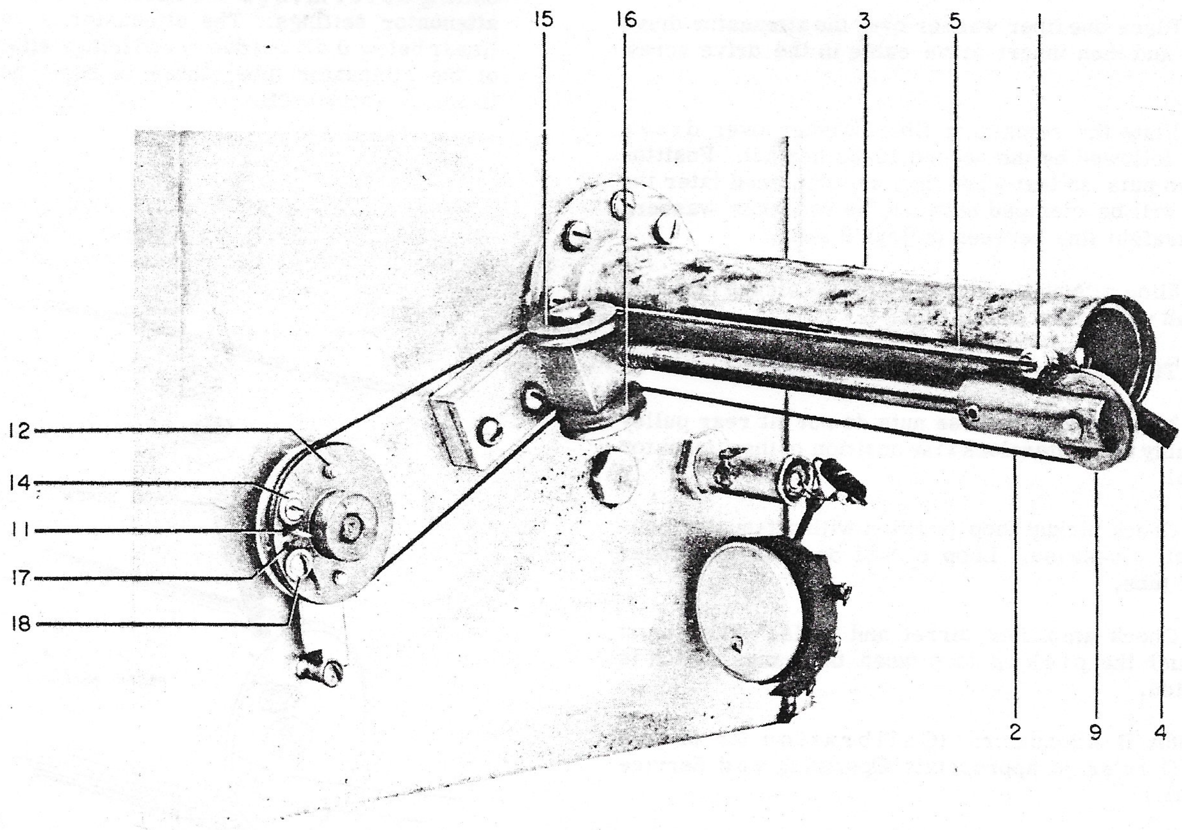
Drive Cable Clamp



End View
Old Style Attenuator



End View
New Style Attenuator



Generator Casting, Attenuator Tube and Drive Mechanism

SERVICE NOTE

P-0330-0075

hp STOCK NO. 0330-0075

INSTALLATION OF MICA DIELECTRIC FOR C33
hp MODEL 608C/D SIGNAL GENERATOR

This Service Note provides the information necessary to replace the RF Bypass Capacitor C33, hp Stock No. 608D-82, in the RF Amplifier Circuit of the hp Model 608C/D VHF Signal Generator.

The replacement mica for this capacitor is held in position only by the pressure of the Amplifier Grid Stator against the Power Amplifier tube seating block. To provide for the variation in thickness of the mica, each replacement mica must be mated with two pieces of silver-plated or very clean brass shim stock, one over and one under the mica. The thickness of shim stock used can be determined by measuring the thickness of the old mica capacitor and shim. This dimension must be maintained by the replacement mica and the proper thickness of replacement shim stock.

To properly install the mica for C33, a thickness gauge, a micrometer, and a small supply of silver plated or very clean brass shim stock are necessary.

PART PROVIDED FOR INSTALLATION

Qty.	Description	hp Stock No.
1	Mica dielectric, .0030 ±.0005" thick 500 vdcw	0330-0075

REPLACEMENT PROCEDURE (Refer to Figure 1 on page 2 when performing following procedure.)

1. Remove RF tuner top and side cover plates.

2. Carefully observe the position of the amplifier grid stator as related to the amplifier plate stator and to the amplifier turret contacts. Measure and record the spacing between the two stators with a thickness gauge.

3. Disconnect the 470 ohm 2 watt, resistor (R57) at the feed thru capacitor.

4. Loosen the 6-32 x 1/2" binding head screw, by several turns, in the ceramic standoff of the grid stator nearest to the mica capacitor. This screw is accessible through the top of the tuner casting.

5. Loosen the 6-32 x 1/2" binding head screw in the other ceramic standoff approximately 1/2 turn. This screw is loosened only 1/2 turn to allow the stator to drop a few thousandths of an inch but not to noticeably alter its position.

6. Remove the mica capacitor C33, shim, and resistor R57 as one unit. Disconnect R57 from original shim.

7. With a micrometer, measure the combined thickness of the original mica and shim. This same combined thickness must be maintained in the new assembly. Use a shim .006" thick under the mica and another shim over the mica to maintain the proper thickness of the assembly.

Note

Shim stock should be 1/2" x 1".

8. Replace the components (as one unit) in the same manner as removed. Connect R57 to lower shim prior to reassembly.

Note

Do not force these components into position. If the combined thickness is correct and the amplifier grid stator is loosened properly, they will slide easily into place.

9. Reposition the amplifier grid stator and tighten the two 6-32 screws. (These screws need only be snug, excessive tension may crack the ceramic standoffs.)

10. Connect R57 to the feed thru capacitor.

11. Replace the RF tuner top and side cover plates.

ADJUSTMENT PROCEDURE

Calibrate your hp Model 608C/D Signal Generator as outlined in the Operating and Service Manual under Calibration of the Percent Modulation and Output Volts Meter.

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6/63

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because of the coupling method used out of the oscillating cavity. However, a Farraday shield at the entrance to the "waveguide-beyond-cutoff" section, such as in the hp Models 614A and 620A, effectively reduces the effect of the TM mode. The attenuation characteristic of the TM mode, being about twice the TE_{11} mode, contributes negligible power to the probe beyond -40 dbm.

Thus, conventional power and attenuation measurement techniques, employing standard test instruments, can be used to verify signal generator output power and attenuation calibration.

In general[4], calibration consists of first verifying actual power output vs frequency by measuring the output level with an accurate microwave power meter (such as hp Model 431) and appropriate thermistor mount (478A coax or 486A series waveguide mounts). This is performed at a "relatively high" power level (typically -7 to -10 dbm)[5]. Attenuator dial tracking can then be verified down to the -40 or -45 dbm power level using sensitive square-law detectors (such as hp 423A or 424A series crystal detectors, or barretters) in conjunction with a high sensitivity, tuned voltmeter such as the hp 415 Standing Wave Indicators. The SWR Indicator actually is an audio frequency attenuation standard calibrated for use with a square-law detector; thus detector conformance to square-law is the major determinant of measurement accuracy.

A variation of this technique is to install a precision variable RF attenuator between the signal generator and detector so that attenuation in the external RF attenuator is reduced as the signal generator output level is attenuated. A constant reference is maintained on the 415 SWR Indicator, and the Signal Generator attenuator's calibration is compared against the external RF attenuator. This method, known as "the RF substitution" technique for attenuation measurement, eliminates the effects of the detector's characteristics because the detector always operates at the same power level.

Signal generator attenuator dial tracking can be checked over a wider range if a laboratory superhetrodyne receiver containing a precision IF attenuator is used as the attenuation standard. This method is commonly referred to as the "IF substitution" technique, and, since it involves linear detection rather than square-law, much wider dynamic range is feasible. Commercially available receivers with precision IF attenuators can readily check attenuation down to power levels in the -80 to -100 dbm region.

Linearity from -40 to -127 dbm actually is assured because attenuation is dependent solely upon the previously checked waveguide dimensions. The only mode in existence at the -40 dbm point and below is the TE_{11} mode, since all higher order modes have been attenuated much more rapidly, and are negligible. The one factor which can influence significantly the relation of power output to probe position below the -40 dbm point is leakage; that is, power that couples into the attenuator probe through the probe's shielded cable (even double shielded cable such as RG-55/U only provides some 80 db of shielding). Thus presence of a strong RF field in the vicinity of the output system could introduce errors when the signal generator output is set at low levels. This implies that a leakage check around the cavity is a very important test to make after klystron replacement or other cavity modifications, such as opening shields or breaking paint seals. In production, hp Signal Generators are tested for leakage down to the maximum sensitivity of receivers. Depending upon the particular generator being tested, it is possible to set shields and in some cases to silver paint joints so that direct cavity leakage is below the perceptible sensitivity of the test receiver. Consequently, even the minimum calibrated output level (typically -127 dbm) from hp signal generators can be utilized with confidence in its accuracy.

Straightforward laboratory receivers can be made quite easily for checking leakage or attenuation linearity by using ordinary crystal mixers, another laboratory generator as the local oscillator, and a simple IF amplifier with a video detector whose output is presented on either a voltmeter (a tuned narrowband voltmeter like the hp 415 SWR Meter improves overall sensitivity) or a standard oscilloscope. Sensitivity of this receiver can normally be easily verified simply by using the attenuator of the generator under test. A simple antenna is then connected to the input of the mixer and is used to probe around the repaired cavity to insure that any leakage is sufficiently low.

Assuming leakage is held to a minimum and the previous techniques are followed closely, excellent agreement between "waveguide - beyond - cutoff" attenuator operation and front panel calibration can be expected; and the operator may be confident that his readings are accurate and his results valid.

There are additional techniques for verifying attenuator calibration down to the -127 dbm level; these usually involve somewhat specialized instrumentation generally used in standards laboratories (the Weinschel Engineering Model VM-3 is an example).

CONCLUSION

The two factors which affect the specified accuracy of Hewlett-Packard signal generator output attenuators are waveguide dimensions and probe frequency response. Both can be checked; waveguide dimensions by mechanical instruments (with electrical verification using substitution techniques) and probe frequency response by electrical instruments. If both are within specifications, specified attenuator accuracy is assured.

[4] Calibration procedures for individual signal generators are described in their Operating and Service Manuals.

[5] In most signal generators accuracy is not usually specified for the first 7 to 10 db of attenuation because, in the area of transition from RF oscillator cavity to waveguide-beyond-cutoff, field patterns may be slightly distorted, causing some non-linearity in the attenuation vs distance curve in this region.

HEWLETT hp PACKARD

HP SIGNAL GENERATOR OUTPUT ATTENUATORS

application note 20

1 JUNE 1965

One of the features which has made Hewlett-Packard Signal Generators so popular is their extremely wide and accurate output power levels. This output versatility is made possible by the attenuator in each signal generator output. For example, the Model 612A Output Attenuator provides an attenuation of up to 127 db with an accuracy of ±1 db. Since even precision attenuators such as the hp Model X382A do not match the performance of these signal generator attenuators, many engineers have asked how Hewlett-Packard achieves extreme accuracy over such a wide output attenuator range. The answer to the question lies in the type of attenuator which is used -- a waveguide-beyond-cutoff type.

The great advantage of this type of attenuator is that its attenuation depends primarily upon its geometrical dimensions.[1] Thus when cutoff attenuators are very carefully constructed, great accuracies are possible. For example, at wavelengths longer than 3 centimeters accuracies as high as 1 part in 10^4 have been achieved.

The simple relation between attenuation and geometrical dimension results from the behavior of a waveguide beyond cutoff. When a waveguide is excited by a frequency lower than its cutoff frequency, the excitation energy dies away exponentially with distance from the point of excitation (in other words, the decibels of attenuation increase linearly with distance from the excitation point).

The equation which expresses the relation between attenuation and waveguide dimensions is:

$$(1)\quad \alpha = \frac{54.6}{\lambda_c}\sqrt{1-\left(\frac{\lambda_c}{\lambda}\right)^2}$$

where: α is the attenuation per unit length (db)
λ_c is the cutoff wavelength
λ^c is the free space wavelength

If λ is much greater than λ_c:

$$(2)\quad \alpha = \frac{54.6}{\lambda_c}$$

[1] The effects of wall conductivity and an oxide layer on the inner waveguide surface are negligible because they contribute an error of only a few parts in 10^4. See "Corrections to the Attenuations of Precision Attenuators", proceedings IEE (Radio and Communications) Vol. 96, Part 3, p. 491, November 1949.

It has been shown[2] that for the TE_{11} mode in circular waveguide,

$$\lambda_c = 3.42\ r$$

where: r is the guide radius.

Substituting in (2)

$$(3)\quad \alpha = \frac{54.6}{\lambda_c} = \frac{54.6}{3.42\,r} = \frac{15.9}{r}$$

Thus we see that the attenuation depends only upon the radius of the waveguide provided that $\lambda >> \lambda_c$[3].

The next question that comes to mind is, how do variations in waveguide size in an actual attenuator affect attenuation? In a typical hp signal generator, the variation of waveguide size is held to less than 5 ten thousandths of an inch by extremely accurate manufacturing techniques. Using equation 3 we can show that this corresponds to an attenuation variation of less than 0.125 db out of 127.

The cutoff attenuator by itself then is an extremely accurate device. Hewlett-Packard has adapted this precise attenuator to a signal generator output attenuator system by delivering the RF oscillations to the cutoff waveguide where they are picked up by a probe and delivered to the front panel. The pickup probe is located in the waveguide and is driven along it through a gear by a knob located on the front panel. Since probe travel is a linear function of attenuation, the knob rotation can be calibrated directly in db.

Although the waveguide beyond cutoff type attenuators are designed for circular guide TE_{11} mode operation, a TM mode may be excited in the -10 to -40 dbm range

[2] Terman, Electronic and Radio Engineering, p. 153, McGraw Hill, New York, 1955.

[3] In actual signal generators λ is actually sufficiently greater than λ_c to make attenuation independent of wavelength or frequency. For example, the Model 612A attenuator has a radius of 0.250 inch which corresponds to a λ_c of 0.885. Using equation (1) above, the attenuation is 63.825 db/in at 450 mc (λ = 66.6 cm) and 63.817 db/in at the upper frequency limit, 1200 mc (λ = 25 cm). The total variation across the whole frequency range is then only 0.008 db/in. Since about two inches of travel is necessary to achieve 127 db, the variation of λ with frequency represents an attenuation variation of only about 0.016 db out of 127. Thus, we are justified in saying that attenuation is for all practical purposes independent of frequency and depends only upon waveguide dimension.

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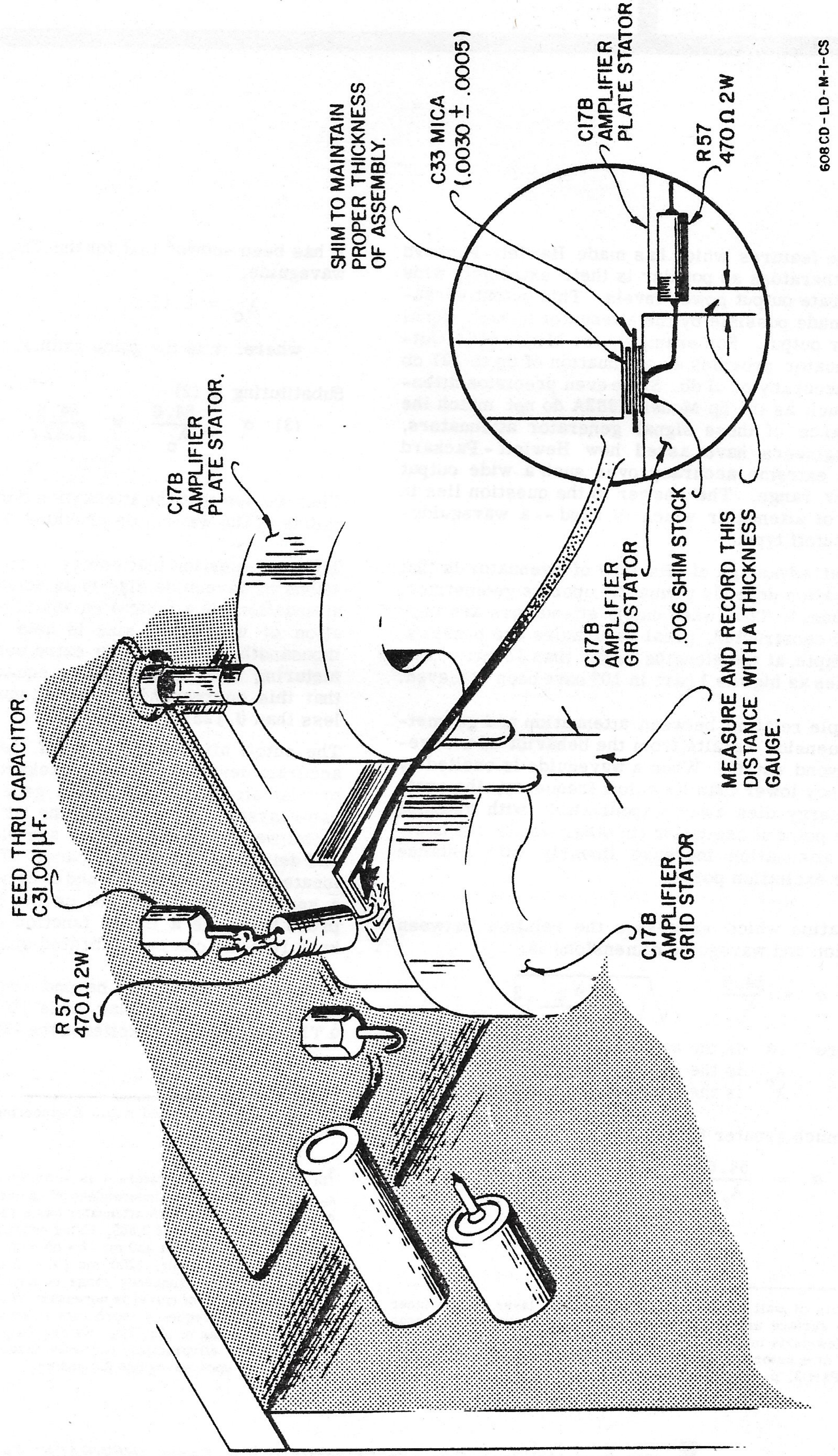

Figure 1. hp Model 608C/D Installation of C33

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